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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6:
C12N 15/62, 9/00
A1
(11) International Publication Number: WO 96/16177
(43) International Publication Date: 30 May 1996 (30.05.96)

(21) International Application Number: PCT/DK95/00463

(22) International Filing Date: 23 November 1995 (23.11.95)

1343/94 24 November 1994 (24.11.94) DR

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(81) Designated States: AL, AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT, UA, UG, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, LS, MW, SD, SZ, UG).

Published

With international search report.

Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: A PROCESS FOR PRODUCING POLYPEPTIDES WITH REDUCED ALLERGENICITY

(57) Abstract

The invention relates to a process for producing polypeptides with reduced allergenicity, by a) fermenting a microorganism capable of producing said polypeptide, b) recovering said polypeptide in substantially pure form, wherein said microorganism is modified in a manner whereby the expressed polypeptide molecules self-oligomerize. Further contemplated are a DNA construct comprising genes encoding such polypeptides, a recombinant expression vector or transformation vehicle comprising said DNA construct, a cell harbouring said DNA construct or vector. Further microbially produced polypeptides with reduced allergenicity produced according to the process of the invention and compositions comprising said polypeptides. Finally the invention relates to the use of Zipper domains for reducing allergenicity of polypeptides.

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Title: A process for producing polypeptides with reduced allergenicity

FIELD OF THE INVENTION

The invention relates to a process for producing polypeptides with reduced allergenicity. Further to a DNA construct comprising genes encoding such polypeptides, a recombinant expression vector or transformation vehicle comprising said DNA construct, a cell harbouring said DNA construct or vector. Also contemplated is polypeptides with reduced allergenicity produced according to the process of the invention, oligomeric polypeptides with reduced allergenicity, and compositions comprising said polypeptides. Finally the invention relates to the use of 15 Zipper domains for reducing the allergenicity of polypeptides.

BACKGROUND OF THE INVENTION

20 An increasing number of polypeptides, including enzymes and non-enzymatic proteins, are being produced industrially for use in industry, household, food/feed, cosmetics, medicine etc. Being polypeptides they are capable of stimulating the immune systems of animals and humans.

25

Allergenicity of polypeptides

Generally, most humans are not exposed to polypeptides to a degree that will generate adverse effects, but certain risk groups exist for which these phenomena are of significant 30 importance.

These risk groups include employees handling the manufacturing products comprising enzymes and professions such as hair-dressers which are daily in direct contact with products comprising polypeptides.

response. At least one of these routes can give adverse effects in humans and animals, as exposure to polypeptides may result in sensitisation and subsequently allergy.

5 While sensitisation is defined as an immune status, allergy is characterized as a clinical disease. Allergy in general requires two or more encounters with antigens. The first exposure lead to a primary immune response which results in sensitisation of the individual. If the sensitised individual comes in contact with the same antigen again it may provoke an allergic response.

More specifically, IgE (or comparable molecules) attach to specific receptors on the surface of mast cells, which contain many large cytoplasmic granules packed with chemical mediators. Once attached to a mast cell, the IgE molecule can survive for many weeks with its antibody reaction site, available to interact with a specific allergen.

20 Individuals having IgE-mediated allergy have many IgE antibodies fixed to mast cells. Upon exposure the specific allergen molecules readily combines with the cell-fixed corresponding IgE antibodies. This leads to cellular release of the cytoplasmic granules of chemical mediators, which gives symptoms like rhinitis, conjunctivitis, uricaria or other allergic reactions.

Such allergic responses occur within minutes or a few hours after exposure to an allergen, and are often referred to as "immediate hypersensitivity reactions".

30

IgE-mediated hypersensitivity reaction may occur when the allergen is introduced via the respiratory tract by inhalation.

The occurrence of allergic responses is believed at least 35 partly to depend on the way of exposure. For instance, it have been found that intranasal challenge with allergenic proteins provokes an allergic response even though skin tests and

negative (Ivan Roitt, "Essential Immunology", fifth edition, p. 152 and p. 240, 1984).

5 Reduction of allergenicity of polypeptides

In general prior art methods for reducing the allergenicity of polypeptides consist of various ways of immobilizing, granulating, coating or dissolving the polypeptides to avoid especially polypeptides in dust form from stimulating the immune system.

10

There will anyhow still be a risk of having polypeptide dust or dissolved polypeptide in aerosol form. Therefore some release of polypeptides can occur leading to a possible sensitisation and subsequent allergic response.

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Another way of diminishing the problem has been to select polypeptides of human origin for production, e.g. in bacteria or mammalian cell cultures. This may alleviate some problems for humans, but not for animals. Furthermore, it will in many cases 20 not be possible to find polypeptides of human origin with the desired properties, for which reason other origin has to be considered. This can be either human polypeptides that are altered in one or more positions in the molecule, giving performance that is desired. It might also be molecules from 25 other species, including bacteria, mold etc. All the latter groups of products will have potency for immune stimulation.

A further proposition for decreasing allergenicity has been to reduce the size of the polypeptide molecules (see e.g. JP 30 Patent Publication No. 4112753, or Research Disclosure No. 335102). This is, however, a solution that is only available when the activity of the polypeptide is without importance, or in such rare cases, where the activity of the polypeptide is question is retained in spite of a breakdown of the polypep-35 tide.

sequent change of the allergenic epitopes (see WO 92/10755 (Novo Nordisk A/S).

In the medicinal field suggestions have been made of diminishing the antigenicity or immunogenicity of polypeptides through
the attachment of one or more polymeric molecules to the polypeptide. This usually has the effect of interfering with the
interactions of the polypeptide with other macromolecular
structures.

10

Such a conjugate may also exhibit novel properties: e.g. EP 38 154 (Beecham Group Ltd.) discloses conjugates of allergens with polysarcosine which have immunosuppressive properties.

15 US patent no. 4,179,337 (Enzon) concerns non-immunogenic polypeptides, such as enzymes and peptide hormones coupled to polyethylene glycol (PEG) or polypropylene glycol. Between 10 and 100 moles of polymer are used per mole polypeptide and at least 15% of the physiological activity is maintained. The protected polypeptide is injected in an aqueous solution either into the mammalian circulatory system or intramuscularly. The non-immunogenicity is assessed from intradermal injection tests.

It has been found that the attachment of one or more polymeric 25 molecules to a polypeptide molecule in general has the effect of reducing the activity of e.g. the enzyme or interfering with the interaction between the enzyme and its substrate.

EP 183 503 (Beecham Group PLC) discloses a development of the 30 above concept by providing conjugates comprising pharmaceutically useful polypeptides linked to at least one water-soluble polymer by means of a reversible linking group.

EP 471 125 (Kanebo, LTD.) describes a modified protease linked 35 to a polysaccharide via a triazine ring leading to a suppressing effect on antigenicity and dermal hypersensitivity. The amployed polysaccharide has an average molecular weight not

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groups in the modified protease is not less that 30%.

In general it is believed that allergens, entering the respiratory tract, must have a molecular weight lower than about 100 kDa in order to penetrate the plasma membrane and cause allergic reactions.

WO 94/10191 (Novo Nordisk A/S) discloses a process for production of low allergenic protein, wherein the monomeric parent protein molecules are linked together to form an oligomer. This is done e.g. by using a linker or spacer molecule or by linking the monomeric molecules together by peptide bonds between the C-terminal of the first monomer and the N-terminal of the second monomer.

15

Folkeson et al., Acta Physiol. Scand, 139, p. 437-354, 1990, showed that there is an inverse relationship between the molecular weight of an instilled protein marker and the transferred amount (bioavaibility) via the respiratory tract to 20 the blood stream.

EP 215 662 (Masda, Hiroshi) concerns a modified or unmodified protease derived from microorganisms for use in medicaments such as anti-tumour agent. The modification of the protease may 25 be carried out by forming dimers or oligomers by cross-linking the protease molecules.

Enlargement of polypeptides by the use of Zipper domains

30 As can be seen from the above different techniques of enlarging polypeptides have been known for some time.

"Zipper technique"

Another technique which may be referred to as "Zipper tech-35 nique" is known to cause oligomerization of polypeptides.

domains (in the following referred to as Zipper domains). Examples of such Zipper domains include the well-known α -helical bundles, crossed bundles, multiple bundles, parallel coiled coils, poly(L-glutamine) strands.

5

The simplest cases of Zipper domains include the helical bundles which consist of amphiphilic helices, e.g. Leucine Zippers and four α -helical bundles. These domains share a characteristic seven-amino acid repeat of the type $(a,b,c,d,e,f,g)_a$. Positions "a" and "d" of the heptad repeat are generally hydrophobic, a property which signals the potential for the interlocking of α -helices, as suggested by Crick (Acta crystallogr., 6, p. 689-697, 1953).

15 Despite the common pattern different sequences form two-, three, four-stranded and even higher order stranded helical bundles (Cohen et. al., TIBS, 11, 245-248, 1986; Cohen, Proteins, vol. 7, p. 1-15, 1990; Cohen, Science 263, p. 488-489, 1994; O'Shea et al., Cell, 68, p. 699-708, 1992; O'Shea et al., Science, 254, p. 539-545, 1991; O'Shea et al. Science, 243, p. 538-542, 1989; Eisenberg et al., Proteins, 1, p.16-22, 1986; Ho et al., J. Am. Chem. Soc, 109, p. 6751-6758, 1987).

An example of a Leucine Zipper is the 33 amino acid sequence 25 located at the C-terminus of GCN4, a yeast transcription factor, which belongs to a class of DNA binding polypeptides (O'Shea et al. Science, 243, p. 538-542, 1989).

Through genetic engineering the specific GCN4 Leucine Zipper 30 has been fused to different polypeptides and shown to mediate dimerization of monomeric polypeptides.

Hu et al., Science, Vol. 250, p. 1400-1403, 1990, describes a genetic system where a GCN4 Leucine Zipper is fused to the N-35 terminal domain of bacteriophage λ repressor and used as a reporter for dimerization.

1991) dimerized a maltose binding protein (MalE) in E. coli.

In general Leucine Zippers form homo-dimers, but within the group of Leucine Zippers there are specific motifs which favour the formation of hetero-dimers. Two examples of such are the Fos and Jun Leucine Zipper (O'Shea et al. Science, 245, p. 646, 1989; Turner and Tjian, Science, 243 p. 1689, 1989) and the artificially made hetero dimeric coiled coil described by O'Shea (Current Biology, vol. 3, no 10, p. 658-667, 1993).

10

Also the above mentioned self-oligomerizing four α-helical bundles have been shown to dimerize with a murine ScFv antibody fragment expressed in E. coli. The antibody fragment is fused to polypeptide motifs (see figure 7) of two identical helices from antiparallel four helical bundle designed by Eisenberg et al., supra, 1986 and Ho et al., supra, 1987, in which the two helices are separated by a turn. The four helix bundle was formed from two molecules each contributing two helices (Pack et al. Bio/Technology, vol. 11, p. 1271-1277, 1993).

20

Concerning Zipper domains resulting in higher order oligomerization, Lovejoy et al., Science, 259, p. 1288, 1993, reported the synthesis of a triple stranded α -helix bundle in which the helices run up-up-down. This construct was made by introducing specific mutations in the otherwise dimerized GCN4 Leucine Zipper.

Incorporation of glutamine repeats (poly(L-glutamine) also makes proteins oligomerize to form polar Zippers (Stott et al., 30 (1995), Proceedings of the National Academy of Sciences of the United States of America 92 (14), p. 6509-6513.

Another polypeptide motif which can mediate trimerization is the naturally occurring motif of the shock transcription factor of Saccharomyces cerevisiae and Kluveromyces lactis described by Peteranderl et al, Biochemistry, 31, p. 12272-12276, 1992.

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residues in the GCN4 Leucine Zipper (Harbury et al., Science, 262, p. 1401-1407, 1993. This was only shown for small peptides.

5 An oligomerization motif from myosin fused to recombinant protein can mediate the formation of higher order polypeptide oligomers (Wolber et al., BIO/TECHNOLOGY, 10, p. 900-904, 1992). The expressed fusion polypeptide forms oligomers at low salt concentration and dissociates at high salt concentrations.

10

Discussion of prior art

All the previously described methods for reducing the allergenicity of polypeptides involve at least one additional 15 production step in comparison to the production of the corresponding parent polypeptides. This makes the processes cumbersome and raises the cost of producing polypeptides with reduced allergenicity.

20 Prior art only describes Zipper domains as means for oligomerizing polypeptides.

It would be desirable to be able to reduce the allergenicity of polypeptides by increasing the size of the polypeptides as an 25 integrated part of the polypeptide production process.

SUMMARY OF THE INVENTION

30 It is the object of the invention to provide an integrated industrial applicable process for producing polypeptides with reduced allergenicity.

The present inventors have perceived the potential of using 35 Zipper domains for industrial uses, and have now surprisingly accomplished to provide a process for producing a polypeptation with reduced allergenicity, by

polypeptide, and

b) recovering said polypeptide in substantially pure form, wherein said microorganism is modified in a manner whereby the expressed polypeptide molecules self-oligomerize.

5

In an embodiment of the invention said microorganism has been modified by the introduction of one or more DNA constructs comprising a DNA sequence coding for at least one polypeptide and at least one Zipper domain.

10

Another object of the invention is to provide a DNA construct for the production of polypeptides with reduced allergenicity, comprising a DNA sequence encoding at least one polypeptide molecule with at least one Zipper domain.

15

The invention also relates to a recombinant vector or transformation vehicle, comprising said DNA construct of the invention, and furthermore to a cell comprising said DNA construct or said recombinant vector or transformation vehicle.

20

Further, the invention is directed towards microbially polypeptides with reduced allergenicity produced according to the process of the invention. Also contemplated are compositions comprising at least one polypeptide component of the invention.

Finally the invention relates to the use of Zipper domains for reducing the allergenicity of polypeptides.

30

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows the DNA sequence and derived amino acid sequence of a linker, the GCN4 Leucine Zipper and a flexible C-terminal sextension peptide containing a cystein amino acid residue.

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Figure 3 shows a coomassie blue stained SDS-PAGE run under non-reducing conditions, wherein lane 4 is a molecular weight marker SeeBlue^m (Cat.: #LC5625, Novex, Inc., Ca, USA), and lanes 2 and 3 are polypeptides expressed by E. coli JM105 comprising 5 the DNA construct pAZ-1.

Figure 4 shows coomassie blue stained SDS-PAGE run under reducing conditions, wherein lane 1 is a molecular weight marker SeeBlue™ (Cat.: #LC5625, Novex, Inc., Ca, USA), and lanes 10 2 and 3 are polypeptides expressed by E. coli JM105 comprising the DNA construct pAZ-1.

Figure 5 shows a Western blot. Lane 1 is the molecular weight marker. Lanes 2 and 3 are samples from the induced JM105/pAZ-1 15 run under non-reduced conditions. Lanes 4 and 5 are the same samples run under reduced conditions.

Figure 6 shows the number of Dunkin Hartley guinea pig, having been exposed to 1.0 μ g monomer and 1.0 μ g dimer Termamyl[®] 20 intratracheally, found to be IgG₁ positive vs. days starting from the day of exposure.

DETAILED DESCRIPTION OF THE INVENTION

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The present inventors have now surprisingly succeeded in providing an integrated industrially applicable process for producing polypeptides with reduced allergenicity, wherein the biological activity of the polypeptides is at least substantially maintained.

A "substantially" maintained activity is in the context of the present invention defined as an activity which is at least between 20% and 30%, preferably between 30% and 40%, more presentably between 40% and 60%, better from 60% up to 80%, even better from 80% up to about 100%, in comparison to the activity

Said polypeptides may be used for a vast number of industrial applications which will be exemplified below.

It is to be understood that, in connection with industrial applications of polypeptides, it is mainly inhalation of the allergens that may inflict a risk of an allergic response. Therefore, one of the crucial advantages of the present invention is, that the inventors have solved the problem of respiratory challenge with allergens, whereas prior art solutions mainly concern dermal challenge with alleged immunogens. Respiratory challenge is a much more sensitive question.

The term "reduced allergenicity" indicates that the amount of produced IgE (in humans, and molecules with comparable effects in specific animals, for instance IgG, in guinea pigs), which can lead to an allergic state are significantly decreased when inhalating a polypeptide of the invention in comparison to the corresponding parent polypeptide.

20 The terms "immunogen", "antigen" and "allergen" are defined below, as these term often are use in an unclean manner, even by scientists.

An "immunogen" may be defined as a substance which when in-25 troduced into humans and animals is capable of stimulating an immunologic response.

The term "antigen" refers to substances which by themselves are capable of generating antibodies when recognized as a non-self 30 molecule by the immune system.

Further, an "allergen" may be defined as an antigen which may give rise to allergic sensitization or an allergic response by IgE antibodies (in humans, and molecules with comparable effects in animals).

As mentioned above it is, at least in the context of polypeptides of the present invention, important to distinguish
between dermal allergens mediating allergic responses caused by
skin contact, and respiratory allergens causing allergic responses by contact with cell-bound IgE in the bronchial tree,
due to the well-known fact that skin tests may be negative even
though inhalation tests provoke an allergic response.

Therefore assessment of allergenicity may be made by inhalation 10 tests, comparing the effect of intratracheal administrated parent polypeptides with the corresponding polypeptides of the invention with reduced allergenicity.

Two main hazard assessment approaches exists, animal models and 15 in vitro models, respectively. Animal models recommended by ECETOC (see Monografi ECETOC no. 19, p. 17-27) includes both mice and guinea pig models.

The mice models focus upon events occurring during the induc-20 tion phase of sensitisation following primary encounter of the substance in question. However, mice are not considered suitable for investigating polypeptides.

In contrast hereto the guinea pig models seek to identify 25 respiratory allergens as a function of elicitation reactions induced in previously sensitised animals. ECETOC assesses results of studies using guinea pig as a suitable basis for hazard assessment in man.

- 30 Specifically, in the context of assessment of allergenicity of polypeptides according to the invention, models involving introduction of polypeptides intratracheal in guiniea pigs are suitable.
- 35 One suitable strain of guinea pigs, the Dunkin Hartley straim, does not (as humans) produce IgE antibodies in connection with

response to inhaled polypeptides (see e.g. Prentø, ATLA, 19, p. 8-14, 1991).

Therefore when using the Dunkin Hartley animal model, the 5 relative amounts of IgG₁A and IgG₁B are a measure for the allergenicity level.

Other animal models such as rats, rabbits etc. could also be used for comparable studies.

10

The production of a polypeptide with reduced allergenicity according to the invention specifically comprises

- a) fermenting a microorganism capable of producing said polypeptide, and
- 15 b) recovering said polypeptide in substantially pure form, wherein said microorganism is modified in a manner whereby the expressed polypeptide molecules self-oligomerize.

The allergenicity of the polypeptides is believed to be reduced 20 by the enlargement of the polypeptides.

The term "self-oligomerization" does in the context of the present invention mean joining together a desired number of polypeptide molecules, e.g. by the use of Zipper domains, and includes dimerization, trimerization, tetramerization, multimerization, polymerization etc.

In a preferred embodiment of the invention the microorganism modified by introducing one or more DNA construct(s) into said 30 microorganism. Said DNA construct comprises a DNA sequence encoding at least one polypeptide of interest operably linked to at least one Zipper domain. Optionally the DNA sequence may further comprise a short linker sequence between the sequence encoding the polypeptide and the Zippper domain and/or a DNA sequence encoding a purification tag.

purification tag the polypeptides may be recovered by IMAC (Immobbilized Metal Affinity Chromatography) following the procedure described in e.g. Yip et al., (1994;, Molecular Biotechnology, vol. 1, p. 151-164; Fatiadi et al., (1987), CRC 5 Critical Rev. Anal. Chem. 18, p. 1-44.

A linker sequence is a DNA sequence encoding an amino acid sequence connecting the polypeptide in question and the Zipper domain.

10

The enlargement of the polypeptides takes place during fermentation. The amino acid sequence of the Zipper domain is expressed grafted to the N- or C-terminal of the polypeptide of interest. When this fusion-polypeptide is expressed Zipper domains associate e.g. two and two and are held together by hydrophobic and electrostatic interactions.

Dependent on the Zipper domain used the fusion polypeptide may also form trimers, tetramers etc.

20

The process of the invention is advantageous due to the fact that no additional step need to be executed after the fermentation and before the recovery to obtain the polypeptide product with reduced allergenicity.

25

Further, it is also an advantage that the process according to the invention may be used for any polypeptides of interest, which may be any polypeptides that in parent form may cause an allergic reaction.

30

This group comprises polypeptides having a molecular weight below about 100 kDa. In general the said molecular weight lies in the range of between about 5 kDa and 150 kDa, preferably from between about 20 kDa and 100 kDa, especially from between 35 about 20 kDa and 80 kDa.

The nolumentides may be of microbial or mammalian origin and

In an embodiment of the invention the polypeptide of integest is an enzyme exhibiting at least one catalytic activity.

Such enzymes may be selected from the group comprising proteas—
5 es (metallo, acid, neutral or alkaline), lipases, cutinases,
cellulases, amylases, lyases, xylanases, pectinases, pullulanase, polygalacturonases, oxidases, laccases, oxidoreductases,
transglutaminases, α-galactocidases, phytases and peroxidases

10 A specific example of such enzyme is Termamyl® (Novo Nordisk A/S), an α-amylase, having a molecular weight of about 55 kDa. The process of the invention enables the production of hybrid products exhibiting more than one biological activity, e.g. hetero-dimeric enzymes which exhibit two different catalytic activities, such as lipolytic and proteolytic activities.

Also contemplated are trimeric, tetrameric, multimeric polypeptides and/or enzymes exhibiting one or more catalytic activities.

20

The polypeptide with reduced allergenicity may be produced by any suitable bacteria or fungal organisms as described below.

DNA construct

- 25 Another object of the invention is to provide a DNA construct for the production of polypeptides with reduced allergenicity, comprising a DNA sequence encoding at least one polypeptide, and at least one Zipper domain.
- 30 As used herein the term "DNA construct" is intended to indicate any nucleic acid molecule of cDNA, genomic DNA, synthetic DNA, RNA or PNA origin. The term "construct" is intended to indicate a nucleic acid segment which may be single- or double-strand and which may be based on a DNA sequence encoding a polypeptide of interest fused to at least one Zipper domain. The construct may optionally contain other DNA segments, such as a short

The DNA construct of the invention may suitably be of genomic or cDNA origin, for instance obtained by preparing a genomic or cDNA library and screening for DNA sequences coding for all or parts of the polypeptide of interest by hybridization using synthetic oligonucleotide probes in accordance with standard techniques (cf. Sambrook et al., Molecular Cloning. A Laboratory Manual, Cold Spring Harbor, NY, 1989).

The DNA sequence may encode a polypeptide exhibiting catalytic 10 activities. In particular, the DNA sequence may encoding at least one enzyme selected from the group comprising proteases (metallo, acid, neutral or alkaline), lipases, cutinases, cellulases, amylases, lyases, xylanases, pectinases, polygalacturonases, oxidases, laccases, oxidoreductases, transglutaminases, α-galactosidases, phytases or peroxidases.

The DNA construct of the invention may also be prepared synthetically by established standard methods, e.g. the phosphomaidite method described by Beaucage and Caruthers, Tetrahedron 20 Letters, 22, p. 1859 - 1869, 1981, or the method described by Matthes et al., EMBO Journal, 3, p. 801 - 805, 1984. According to the phosphoamidite method, oligonucleotides are synthesized, e.g. in an automatic DNA synthesizer, purified, annealed, ligated and cloned in suitable vectors.

25

Furthermore, the DNA construct may be of mixed synthetic and genomic, mixed synthetic and cDNA or mixed genomic and cDNA origin prepared by ligating fragments of synthetic, genomic or cDNA origin (as appropriate), the fragments corresponding to various parts of the entire DNA construct, in accordance with standard techniques.

The DNA construct may also be prepared by polymerase chain reaction using specific primers, for instance as described in 35 US 4,683,202 or Saiki et al., Science, 239, p. 487 - 491, 1988.

In a specific embodiment the DNA construct of the invention

nucleic acid sequences encoding the amino acid sequence shown in SEQ ID NO 2, but may differ from the DNA sequence shown in SEQ ID NO 1 by virtue of the degeneracy of the genetic code.

5 Recombinant vector

In a further aspect the present invention relates to a recombinant vector or transformation vehicle comprising a DNA construct of the invention. The recombinant vector into which the DNA construct of the invention is inserted may be any vector which may conveniently be subjected to recombinant DNA procedures, and the choice of vector will often depend on the host cell into which it is to be introduced. Thus, the vector may be an autonomously replicating vector, i.e. a vector which exists as an extrachromosomal entity, the replication of which is integrated of chromosomal replication, e.g. a plasmid. Alternatively, the vector may be one which, when introduced into a host cell, is integrated into the host cell genome and replicated together with the chromosome(s) into which it has been integrated.

20

The vector is preferably an expression vector in which the DNA sequence encoding the polypeptide of interest to be self-oligomerized is operably linked to additional segments required for transcription of the DNA. In general, the expression vector is 25 derived from plasmid or viral DNA, or may contain elements of both. The term, "operably linked" indicates that the segments are arranged so that they function in concert for their intended purposes, e.g. transcription initiates in a promoter and proceeds through the DNA sequence coding for the polypeptide of interest.

The promoter may be any DNA sequence which shows transcriptional activity in the host cell of choice and may be derived from genes encoding polypeptides either homologous or 35 heterologous to the host cell.

J. Biol. Chem., 255, p. 12073 - 12080, 1980; Alber and Kawasaki, J. Mol. Appl. Gen., 1, p. 419 - 434, 1982) or alcohol dehydrogenase genes (Young et al., in Genetic Engineering of Microorganisms for Chemicals (Hollaender et al, eds.), Plenum Press, New York, 1982), or the TPI1 (US 4,599,311) or ADH2-4c (Russell et al., Nature, 304, p. 652 - 654, 1983) promoters.

Examples of suitable promoters for use in filamentous fungus host cells are, for instance, the ADH3 promoter (McKnight et 10 al., The EMBO J., 4, p. 2093 - 2099, 1985) or the tpiA promoter. Examples of other useful promoters are those derived from the gene encoding A. oryzae TAKA amylase, Rhizomucor miehei aspartic proteinase, A. niger neutral \alpha-amylase, A. niger acid stable \alpha-amylase, A. niger or A. awamori glucoamylase (gluA), 15 Rhizomucor miehei lipase, A. oryzae alkaline protease, A. oryzae triose phosphate isomerase or A. nidulans acetamidase. Preferred are the TAKA-amylase and gluA promoters.

Examples of suitable promoters for use in bacterial host cells include the promoter of the Bacillus stearothermophilus maltogenic amylase gene, the Bacillus licheniformis alphamylase gene, the Bacillus amyloliquefaciens BAN amylase gene, the Bacillus subtilis alkaline protease gen, or the Bacillus pumilus xylosidase gene, or by the phage Lambda P_R or P_L 25 promoters or the E. coli lac, trp or tac promoters.

The DNA sequence may also, if necessary, be operably connected to a suitable terminator.

30 The recombinant vector of the invention may further comprise a DNA sequence enabling the vector to replicate in the host cell in question..

The vector may also comprise a selectable marker, e.g. a gene 35 the product of which complements a defect in the host cell, such as the gene coding for dihydrofolate reductase (DHFR) or the Schizosaccharomyces pombe TPI gene (described by P.R.

resistance to a drug, e.g. ampicillin, kanamycin, tetracyclin, phleomycin, chloramphenicol, neomycin, hygromycin or methotrexate. For filamentous fungi, selectable markers include amdS, pyrG, argB, niaD, trpC and sC.

5

To direct the polypeptide into the secretory pathway of the host cells, a secretory signal sequence (also known as a leader sequence, prepro sequence or pre sequence) may be provided in the recombinant vector. The secretory signal sequence is joined 10 to the DNA sequence encoding the polypeptide in the correct reading frame. Secretory signal sequences are commonly positioned 5' to the DNA sequence encoding the polypeptide. The secretory signal sequence may be that normally associated with the polypeptide or may be from a gene encoding another secreted 15 polypeptide.

For secretion from yeast cells, the secretory signal sequence may encode any signal peptide which ensures efficient direction of the expressed polypeptide into the secretory pathway of the cell. The signal peptide may be naturally occurring signal peptide, or a functional part thereof, or it may be a synthetic peptide. Suitable signal peptides have been found to be the α-factor signal peptide (cf. US 4,870,008), the signal peptide of mouse salivary amylase (cf. O. Hagenbuchle et al., Nature, 289, p. 643-646, 1981), a modified carboxypeptidase signal peptide (cf. L.A. Valls et al., Cell, 48, p. 887-897, 1987), the yeast BAR1 signal peptide (cf. WO 87/02670), or the yeast aspartic protease 3 (YAP3) signal peptide (cf. M. Egel-Mitani et al., Yeast, 6, p. 127-137, 1990).

30

For efficient secretion in yeast, a sequence encoding a leader peptide may also be inserted downstream of the signal sequence and upstream of the DNA sequence encoding the polypeptide. The function of the leader peptide is to allow the expressed polypeptide to be directed from the endoplasmic reticulum to the Golgi apparatus and further to a secretory vesicle for

cellular membrane into the periplasmic space of the yeast cell). The leader peptide may be the yeast α-factor leader (the use of which is described in e.g. US 4,546,082, EP 16 201, EP 123 294, EP 123 544 and EP 163 529). Alternatively, the leader peptide may be a synthetic leader peptide, which is to say a leader peptide not found in nature. Synthetic leader peptides may, for instance, be constructed as described in WO 89/02463 or WO 92/11378.

- 10 For use in filamentous fungi, the signal peptide may conveniently be derived from a gene encoding an Aspergillus sp. amylase or glucoamylase, a gene encoding a Rhizomucor miehei lipase or protease or a Humicola lanuginosa lipase.
- 15 The signal peptide is preferably derived from a gene encoding A. oryzae TAKA amylase, A. niger neutral α -amylase, A. niger acid-stable amylase, or A. niger glucoamylase.

In a preferred specific embodiment of the invention said vector 20 is the pAZ-1 expression vector.

The procedures used to ligate the DNA sequences coding for the polypeptide in question, the promoter and optionally the terminator and/or secretory signal sequence, respectively, and to insert them into suitable vectors containing the information necessary for replication, are well known to persons skilled in the art (cf., for instance, Sambrook et al., supra, 1989).

Host cell

- The DNA sequence encoding the fusion polypeptide in question, introduced into the host cell may be either homologous or heterologous to the host in question. If homologous to the host cell, i.e. produced by the host cell in nature, it will typically be operably connected to another promoter sequence or, if applicable, another secretory signal sequence and/or
 - terminator sequence than in its natural environment. The term

"heterologous" is intended to include a DNA sequence not expressed by the host cell in nature. Thus, the DNA sequence may be from another organism, or it may be a synthetic sequence.

- 5 The host cell into which the DNA construct or the recombinant vector of the invention is introduced may be any cell which is capable of producing the polypeptide of interest and includes bacteria, yeast, filamentous fungi.
- capable of producing the polypeptide of interest are grampositive bacteria such as strains of Bacillus, such as strains of B. subtilis, B. licheniformis, B. lentus, B. brevis, B. steatothermophilus, B. alkalophilus, B. amyloliquefaciens, B. cargulans, B. circulans, B. lautus, B. megaterium or B. thurin-
- 15 coagulans, B. circulans, B. lautus, B. megaterium or B. thuringiensis, or strains of Streptomyces, such as S. lividans, S.
 murinus or S. griseus, or gramnegative bacteria such as Escherichia coli. The transformation of the bacteria may be effected
 by protoplast transformation or by using competent cells in a
 20 manner known per se (cf. Sambrook et al., supra).

When expressing the polypeptide in bacteria such as E. coli, the polypeptide may be retained in the cytoplasm, typically as insoluble granules (known as inclusion bodies), or may be directed to the periplasmic space by a bacterial secretion sequence. In the former case, the cells are lysed and the granules are recovered and denatured after which the polypeptide is refolded by diluting the denaturing agent. In the latter case, the polypeptide may be recovered from the periplasmic space by disrupting the cells, e.g. by sonication or osmotic shock, to release the contents of the periplasmic space and recovering the polypeptide.

Examples of suitable yeasts cells include cells of Saccharomy-35 ces spp. or Schizosaccharomyces spp., in particular strains of Saccharomyces cerevisiae or Saccharomyces kluyveri. Methods for

4,599,311, US 4,931,373, US 4,870,008, 5,037,743, and US 4,845,075, all of which are hereby incorporated by reference. Transformed cells are selected by a phenotype determined by a selectable marker, commonly drug resistance or the ability to 5 grow in the absence of a particular nutrient, e.g. leucine. A preferred vector for use in yeast is the POT1 vector disclosed in US 4,931,373. The DNA sequence encoding the polypeptide of the invention may be preceded by a signal sequence and optionally a leader sequence, e.g. as described above. Further 10 examples of suitable yeast cells are strains of Kluyveromyces, such as K. lactis, Hansenula, e.g. H. polymorpha, or Pichia, e.g. P. pastoris (cf. Gleeson et al., J. Gen. Microbiol. 132, 1986, p. 3459-3465; US 4,882,279).

e.g. Aspergillus spp., Neurospora spp., Fusarium spp. or Trichoderma spp., in particular strains of A. oryzae, A. nidulans or A. niger. The use of Aspergillus spp. for the expression of polypeptides is described in, e.g., EP 272 277, 20 EP 238 023 and EP 184 438. The transformation of F. oxysporum may, for instance, be carried out as described by Malardier et al., Gene, 78, p. 147-156, 1989.

When a filamentous fungus is used as the host cell it may be
transformed with the DNA construct of the invention conveniently by integrating the DNA construct in the host chromosome
to obtain a recombinant host cell. This integration is generally considered to be an advantage as the DNA sequence is more
likely to be stably maintained in the cell. Integration of the
DNA constructs into the host chromosome may be performed according to conventional methods, e.g. by homologous or heterologous recombination.

The transformed host cell described above is then cultured in 35 a suitable nutrient medium under conditions permitting the expression of the polypeptide of interest, after which the resulting polypeptide is recovered from the culture.

The medium used to culture the cells may be any conventional medium suitable for growing the host cells, such as minimal or complex media containing appropriate supplements. Suitable media are available from commercial suppliers or may be prepared according to published recipes (e.g. in catalogues of the American Type Culture Collection). The polypeptide produced by the cells may then be recovered from the culture medium by conventional procedures including separating the host cells from the medium by centrifugation or filtration, precipitating the proteinaceous components of the supernatant or filtrate by means of a salt, e.g. ammonium sulphate, purification by a variety of chromatographic procedures, e.g. ion exchange chromatography, gelfiltration chromatography, affinity chromatography, or the like, dependent on the type of polypeptide in 15 question.

Polypeptides

The invention is also directed towards polypeptides with reduced allergenicity produced according to a process of the invention.

The polypeptide of the invention consist of a Zipper domain fused to the polypeptide of interest. The N- or C-terminal of the amino acid sequence of the polypeptide is grafted to the 25 Zipper domain.

The Zipper domain may be any domain capable of oligomerizing the polypeptides in the production phase. In a specific embodiment the Zipper domain is a Leucine Zipper, such as the 30 GCN4 Leucine Zipper.

Preferably the monomeric polypeptide has a molecular weight of between 5 kDa and 150 kDa, preferable between 20 kDa and 100 kDa, especially between 20 kDa and 80 kDa.

keep the homo-dimer stable. However, to further stabilize the dimer, a cysteine may be included in the Leucine Zipper. This construction can lead to the formation of a disulfide bridge between the two monomers of hybrid polypeptide.

5

The polypeptide of the invention comprises from 2 to 10 polypeptide molecules or more. In a preferred embodiment the self-oligomerized polypeptide is a dimer, a trimer, a tetramer, or an oligomer.

10

It is possible to persist or resume the biological activity of the polypeptide, e.g. the enzymatic activity of a dimerized enzyme.

15 Further the polypeptide of the invention may exhibit more than one biological activity, e.g. two or more different enzymatic activities, such as lipolytic and proteolytic activities.

Oligomeric polypeptides

The invention also related to oligomeric polypeptides with reduced allergenicity comprising at least one polypeptide bonded or linked to at least one Zipper domain which is coupled to at least one polypeptide bonded or linked to at least one Zipper domain.

25

Said oligomeric polypeptides may be homo-oligomeric, heterooligomeric or higher order oligomeric polypeptide produced by any suitable process or prepared by any suitable method.

30 Said Zipper domain may be any of the previously mentioned Zipper domains.

In an embodiment said oligomeric polypeptide exhibits at least one of the previously mentioned enzymatic activities.

35

Said Zipper domain may be linked to either the C- or N-terminal of the polypeptide(s) in question.

In the following the term "polypeptide" includes both polypeptides produced according to the process of the invention and said oligomeric polypeptides of the invention.

5 A polypeptide according to the invention may demonstrate a high degree of controlled stability.

In certain cases the polypeptides may advantageously be irreversible fused together, which entails that the product has 10 only negligible tendency to disintegrate, which would lead to the return of conditions that may cause an allergenic state.

However in certain other cases, it is advantageous that the polypeptides stay oligomerized in the production and/or bulk 15 handling phase, but dissociates later on, when the polypeptides does not inflict a risk of exposure to humans or animals.

The cleavage of the linkage between the polypeptides may be activated e.g. by physical conditions, such as pH, ionic 20 strength, temperature, reduction or oxidation potential etc.

Further the presence of specific compounds may result in dissociating e.g. into lower order oligomers or monomers.

25 Especially in the case where the activity of the polypeptides are reduced in the oligomerized form, dissociation may be advantageous.

Composition

30 The invention also relates to a composition comprising at least one polypeptide and/or at least one oligomeric polypeptide of the invention.

The composition may further comprise other ingredients normally used in e.g. detergents, including soap bars, household articles, agrochemicals, personal care products, cosmetics, toile-

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26

Detergent compositions

According to the invention, a polypeptide of the invention may be an enzyme used in detergent compositions. It may be included in the detergent composition in the form of a non-dusting 5 granulate, a stabilized liquid, or a protected enzyme. Nondusting granulates may be produced, e.g., as disclosed in US 4,106,991 and 4,661,452 (both to Novo Industri A/S) and may optionally be coated by methods known in the art. Examples of waxy coating materials are poly(ethylene oxide) products 10 (polyethyleneglycol, PEG) with mean molecular weights of 1000 to 20000; ethoxylated nonylphenols having from 16 to 50 ethylene oxide units; ethoxylated fatty alcohols in which the alcohol contains from 12 to 20 carbon atoms and in which there are 15 to 80 ethylene oxide units; fatty alcohols; fatty acids; 15 and mono- and di- and triglycerides of fatty acids. Examples of film-forming coating materials suitable for application by fluid bed techniques are given in patent GB 1483591. Liquid enzyme preparations may, for instance, be stabilized by adding a polyol such as propylene glycol, a sugar or sugar alcohol, 20 lactic acid or boric acid according to established methods. Other enzyme stabilizers are well known in the art. Protected enzymes may be prepared according to the method disclosed in EP 238,216.

- 25 The detergent composition may be in any convenient form, e.g. as powder, granules, paste or liquid. A liquid detergent may be aqueous, typically containing up to 70% water and 0-30% organic solvent, or nonaqueous.
- olefinsulfonate (AOS), alkyl sulfate (fatty alcohol sulfate)
- 35 (AS), alcohol ethoxysulfate (AEOS or AES), secondary alkanesulfonates (SAS), alpha-sulfo fatty acid methyl esters, alkyl- or alkenvlsuccinic acid, or soap. It may also contain 0-40% of

carboxylated alcohol ethoxylates, nonylphenol ethoxylate, alkylpolyglycoside, alkyldimethylamine oxide, ethoxylated fatty acid monoethanolamide, fatty acid monoethanolamide, or polyhydroxy alkyl fatty acid amide (e.g. as described in WO 5 92/06154).

The detergent composition may additionally comprise one or more enzymes, such as e.g. amylases, lipases, cutinases, proteases, cellulases, peroxidases, and oxidases.

- The detergent may contain 1-65% of a detergent builder or complexing agent such as zeolite, diphosphate, triphosphate, phosphonate, citrate, nitrilotriacetic acid (NTA), ethylene-
- diaminetetraacetic acid (EDTA), diethylenetriaminepentaacetic acid (DTMPA), alkyl- or alkenylsuccinic acid, soluble silicates or layered silicates (e.g. SKS-6 from Hoechst). The detergent may also be unbuilt, i.e. essentially free of detergent builder.
- The detergent may comprise one or more polymers. Examples are carboxymethylcellulose (CMC), poly(vinylpyrrolidone) (PVP), polyethyleneglycol (PEG), poly(vinyl alcohol) (PVA), polycarboxylates such as polyacrylates, maleic/acrylic acid copolymers and lauryl methacrylate/acrylic acid copolymers.
- The detergent may contain a bleaching system which may comprise a H₂O₂ source such as perborate or percarbonate which may be combined with a peracid-forming bleach activator such tetraacetylethylenediamine (TAED) or nonanoyloxybenzenesulfonate (NOBS). Alternatively, the bleaching system may comprise peroxyacids of, e.g., the amide, imide, or sulfone type.

The detergent composition of the invention comprising the polypeptide of the invention may be stabilized using conventional stabilizing agents, e.g. a polyol such as propylene glycol or glycerol, a sugar or sugar alcohol, lactic acid,

described in, e.g., WO 92/19709 and WO 92/19708.

The detergent may also contain other conventional detergent ingredients such as, e.g., fabric conditioners including clays, foam boosters, suds suppressors, anti-corrosion agents, soil—suspending agents, anti-soil-redeposition agents, dyes, bactericides, optical brighteners, or perfume.

The pH (measured in aqueous solution at use concentration) will 10 usually be neutral or alkaline, e.g. in the range of 7-11.

Particular forms of detergent compositions within the scope of the invention include:

15 1) A detergent composition formulated as a granulate having a bulk density of at least 600 g/l comprising

 linear alkylbenzenesulfonate (calculated as acid) 	7 -	12	ક
<pre>20 - alcohol ethoxysulfate (e.g. C₁₂₋₁₈ alcohol, 1-2 EO) or alkyl sulfate (e.g. C₁₆₋₁₈)</pre>	1 -	4	ક
- alcohol ethoxylate 25 (e.g. C ₁₄₋₁₅ alcohol, 7 EO)	5 -	9	ક
- sodium carbonate (as Na ₂ CO ₃) 14 - 20%			
- soluble silicate (as Na ₂ O, 2SiO ₂)	2 -	6	ક
- zeolite (as NaAlSiO ₄)	15 -	22	. %
- sodium sulfate (as Na ₂ SO ₄)	0 -	. 6	8
35 - sodium citrate/citric acid	0 -	15	;8
(as $C_6H_5Na_3O_7/C_6H_8O_7$) - sodium perborate (as $NaBO_3.H_2O$)	11 -	- 18	} %
- TAED	2 -	- 6	58
<pre>40 - carboxymethylcellulose</pre>	0 -	- 2	28
 polymers (e.g. maleic/acrylic acid copolymer, PVP, PEG) 	0 -	- 3	3 %
45 - enzymes	0 -	- 9	58

suppressors, perfume, optical 0 - 5% brightener, photobleach) 5 2) A detergent composition formulated as a granulate having a bulk density of at least 600 g/l comprising - linear alkylbenzenesulfonate 6 - 11% (calculated as acid) 10 - alcohol ethoxysulfate (e.g. C_{12-18} alcohol, 1-2 EO) 38 or alkyl sulfate (e.g. C₁₆₋₁₈) alcohol ethoxylate 5 - 9% 15 (e.g. C₁₄₋₁₅ alcohol, 7 EO) 15 - 21% - sodium carbonate (as Na₂CO₃) 1 - 4% - soluble silicate (as Na₂O, 2SiO₂) 20 24 - 34%- zeolite (as NaAlSiO₄) 4 - 10% - sodium sulfate (as Na₂SO₄) 0 - 15% 25 - sodium citrate/citric acid $(as C_6H_5Na_3O_7/C_6H_8O_7)$ 0 - 2% - carboxymethylcellulose - polymers (e.g. maleic/acrylic acid copolymer, 68 30 PVP, PEG) 5% 0 enzymes - minor ingredients 0 - 5% 35 (e.g. suds suppressors, perfume) 3) A detergent composition formulated as a granulate having a bulk density of at least 600 g/l comprising 40 - linear alkylbenzenesulfonate 5 - 9% (calculated as acid) alcohol ethoxylate 7 - 148(e.g. C_{12-15} alcohol, 7 EO) 45 - soap as fatty acid 1 - 3% (e.g. C₁₆₋₂₂ fatty acid) 10 - 17% - sodium carbonate (as Na₂CO₃) 50 3 - 9% - soluble silicate (as Na₂O,ciao₂)

- alcohol ethoxylate

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	30	
	- sodium sulfate (as Na ₂ SO ₄)	0 - 4%
	- sodium perborate (as NaBO3.H2O)	8 - 16%
5	- TAED	2 - 8%
10	- phosphonate (e.g. EDTMPA)	0 - 1%
	- carboxymethylcellulose	0 - 2%
	 polymers (e.g. maleic/acrylic acid copolymer, PVP, PEG) 	o - 3%
	- enzymes	0 - 5%
15	 minor ingredients (e.g. suds suppressors, perfume, optical brightener) 	0 - 5%
20	4) A detergent composition formulated as a grabulk density of at least 600 g/l comprising	nulate having a
25	 linear alkylbenzenesulfonate (calculated as acid) 	8 - 12%
25	- alcohol ethoxylate	10 - 25%
30	- sodium carbonate (as Na ₂ CO ₃) 14 - 22%	
30	- soluble silicate (as Na ₂ O, 2SiO ₂)	1 - 5%
	- zeolite (as NaAlSiO ₄)	25 - 35%
35	- sodium sulfate (as Na ₂ SO ₄)	0 - 10%
	- carboxymethylcellulose	0 - 2%
40	 polymers (e.g. maleic/acrylic acid copolymer PVP, PEG) 	1 - 3%
	- enzymes	0 - 5%
45	- minor ingredients (e.g. suds suppressors, perfume)	0 - 5%
	5) An aqueous liquid detergent composition com	prising
50	- linear alkylbenzenesulfonate (calculated as acid)	15 - 21%

5%

5%

molar ratio 25:1; MW 3800

50

glycerol

		optical brighteners)	0	-	5%	
	7)	A detergent composition formulated as a gra	nu	1a1	te ha	ving a
5	bu	lk density of at least 600 g/l comprising				
	_	fatty alcohol sulfate	5	-	10%	
	-	ethoxylated fatty acid monoethanolamide	3		98	
10	-	soap as fatty acid	0	-	38	
	-	sodium carbonate (as Na ₂ CO ₃) 5 - 10%				
	-	soluble silicate (as Na20,2SiO2)	1	-	48	
15	_	zeolite (as NaAlSiO ₄)	20	-	40%	
	_	sodium sulfate (as Na ₂ SO ₄)	2	-	88	
20	-	sodium perborate (as NaBO3.H2O)	12	-	18%	
	-	TAED	2	-	78	
25		polymers (e.g. maleic/acrylic acid copolymer PEG)	·, 1	-	5%	
	-	enzymes	0	-	5%	
30		minor ingredients (e.g. optical brightener, suds suppressors, perfume)	0	_	5%	
	8	A detergent composition formulated as a gran	ul	ate	e com	prising
		linear alkylbenzenesulfonate (calculated as acid)	8	, –	14%	
35	-	ethoxylated fatty acid monoethanolamide	5	, –	11%	
	-	soap as fatty acid	C	, –	3 %	
40	-	sodium carbonate (as Na ₂ CO ₃) 4 - 10%				
	-	soluble silicate (as Na ₂ O, 2SiO ₂)	3	_	- 4 \$	
		zeolite (as NaAlSiO4)	30) -	- 50%	
4.5		sodium sulfate (as Na ₂ SO ₄)	3	3 -	- 11%	
	_	sodium citrate (as C ₆ H ₅ Na ₃ O ₇) 5 - 12%				
50) -	polymers (e.g. PVP, maleic/acrylic acid copolymer, PEG)		1 -	- . 5%	

	<pre>- minor ingredients (e.g. suds suppressors, perfume)</pre>	0 - 5%
5	9) A detergent composition formulated as a gran	ulate comprising
	 linear alkylbenzenesulfonate (calculated as acid) 	6 - 12%
10	- nonionic surfactant,	1 - 4%
	- soap as fatty acid	2 - 6%
	- sodium carbonate (as Na ₂ CO ₃) 14 - 22%	
15	- zeolite (as NaAlSiO ₄)	18 - 32%
	- sodium sulfate (as Na ₂ SO ₄)	5 - 20%
	- sodium citrate (as $C_6H_5Na_3O_7$) 3 - 8%	
20	- sodium perborate (as NaBO3.H2O)	4 - 9%
	- bleach activator (e.g. NOBS or TAED)	1 - 5%
25	- carboxymethylcellulose	0 - 2%
	- polymers (e.g. polycarboxylate or PEG)	1 - 5%
	- enzymes	0 - 5%
30	 minor ingredients (e.g. optical brightener, perfume) 	0 - 5%
35	10) An aqueous liquid detergent composition c	omprising
	 linear alkylbenzenesulfonate (calculated as acid) 	15 - 23%
40	- alcohol ethoxysulfate (e.g. C ₁₂₋₁₅ alcohol, 2-3 EO)	8 - 15%
<i>A</i> 5	<pre>- alcohol ethoxylate (e.g. C₁₂₋₁₅ alcohol, 7 EO, or C₁₂₋₁₅ alcohol, 5 EO)</pre>	3 - 9%
45	- soap as fatty acid (e.g. lauric acid)	0 - 3%
50	- aminoethanol	1 - 5%
	- sodium citrate	5 - 10%
	- hydrotrope (e.g. sodium toluenesulfonate)	2 - 6%

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34				
- carboxymethylcellulose	0 - 1%			
- ethanol	1 - 3%			
5 - propylene glycol	2 - 5%			
- enzymes	0 - 5%			
- minor ingredients (e.g. polymers, dispersant perfume, optical brighteners)	0 - 5%			
11) An aqueous liquid detergent composition co	omprising			
- linear alkylbenzenesulfonate 15 (calculated as acid)	20 - 32%			
<pre>- alcohol ethoxylate (e.g. C₁₂₋₁₅ alcohol, 7 EO, or C₁₂₋₁₅ alcohol, 5 EO)</pre>	6 - 12%			
- aminoethanol	2 - 6%			
- citric acid	8 - 14%			
25 - borate (as B ₄ O ₇)	1 - 3%			
 polymer (e.g. maleic/acrylic acid copolymer anchoring polymer such as, e.g., lauryl methacrylate/acrylic acid copolymer) 	0 - 3%			
- glycerol	3 - 8%			
- enzymes	0 - 5%			
minor ingredients (e.g. hydrotropes,dispersants, perfume, optical brighteners)	0 - 5%			
40 12) A detergent composition formulated as a a bulk density of at least 600 g/l comprising				
 anionic surfactant (linear alkylbenzenesulfonate, alkyl sulfate, alpha olefinsulfonate, alpha-sulfo fatty acid methyl esters, alkanesulfonates, soap) 				
 nonionic surfactant (e.g. alcohol ethoxylate) 	1 - 10%			
50 - sodium carbonate (as Na ₂ CO ₃) 8 - 25%				
- soluble silicates (as Na20, 2SiO2)	5 - 15%			

- zeolite (as NaAlSiO4)	15 - 28%
- sodium perborate (as NaBO3.4H2O)	0 - 20%
5 - bleach activator (TAED or NOBS)	0 - 5%
- enzymes	0 - 5%
<pre>- minor ingredients 10 (e.g. perfume, optical brighteners)</pre>	0 - 3%

- 13) Detergent formulations as described in 1) 12) wherein all or part of the linear alkylbenzenesulfonate is replaced by $(C_{12}$ 15 C_{18}) alkyl sulfate .
 - 14) A detergent composition formulated as a granulate having a bulk density of at least 600 g/l comprising

20 - (C ₁₂ -C ₁₈) alkyl sulfate 9 -	- 15%
- alcohol ethoxylate	3 - 6%
 polyhydroxy alkyl fatty acid amide 	1 - 5%
- zeolite (as NaAlSiO ₄)	10 - 20%
- layered disilicate (e.g. SK56 from Hoechst)	10 - 20%
- sodium carbonate (as Na ₂ CO ₃) 3	- 12%
- soluble silicate (as Na ₂ O, 2SiO ₂)	0 - 6%
35 - sodium citrate	4 - 8%
- sodium percarbonate	13 - 22%
- TAED	3 - 8%
<pre>40 - polymers (e.g. polycarboxylates and P</pre>	VP) 0 - 5%
- enzymes	0 - 5%
<pre>45 - minor ingredients (e.g. optical brightener, photo bleach, perfume, suds suppressors)</pre>	0 - 5%

^{50 15)} A detergent composition formulated as a granulate having a bulk density of at least 600 g/l comprising

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	_	alcohol ethoxylate	11	-	15%
	_	soap	1	-	4%
5	-	zeolite MAP or zeolite A	35	-	45%
	-	sodium carbonate (as Na ₂ CO ₃) 2 - 8%			
	-	soluble silicate (as Na ₂ O, 2SiO ₂)	0	-	48
10	-	sodium percarbonate	13	-	22%
	-	TAED	1	-	88
15	-	carboxymethyl cellulose	0	-	3%
	_	polymers (e.g. polycarboxylates and PVP)	0	-	3%
	-	enzymes	0	-	5%
20	_	minor ingredients (e.g. optical brightener, phosphonate, perfume)	0	-	3%

- 25 16) Detergent formulations as described in 1) 15) which contain a stabilized or encapsulated peracid, either as an additional component or as a substitute for already specified bleach systems.
- 30 17) Detergent compositions as described in 1), 3), 7), 9) and 12) wherein perborate is replaced by percarbonate.
 - 18) Detergent compositions as described in 1), 3), 7), 9), 12),
 - 14) and 15) which additionally contain a manganese catalyst.
 - 35 The manganese catalyst may, e.g., be one of the compounds described in "Efficient manganese catalysts for low-temperature bleaching", Nature, 369, p. 637-639, 1994.
 - 19) Detergent composition formulated as a nonaqueous detergent 40 liquid comprising a liquid nonionic surfactant such as, e.g., linear alkoxylated primary alcohol, a builder system (e.g. phosphate), enzyme and alkali. The detergent may also comprise anionic surfactant and/or a bleach system.

37

concentrations conventionally employed in detergents. It is at present contemplated that, in the detergent composition of the invention, the enzyme in question with reduced allergenicity may be added in an amount corresponding to 0.001-100 mg of enzyme per liter of wash liquor.

Dishwashing composition

The polypeptides of the invention with reduced allergenicity may also advantageously be used in dishwashing detergents.

10

Dishwashing detergent compositions comprise a surfactant which may be anionic, non-ionic, cationic, amphoteric or a mixture of these types. The detergent will contain 0-90% of non-ionic surfactant such as low- to non-foaming ethoxylated propoxylated straight-chain alcohols.

The detergent composition may contain detergent builder salts of inorganic and/or organic types. The detergent builders may be subdivided into phosphorus-containing and non-phosphorus-containing types. The detergent composition usually contains 1-90% of detergent builders.

Examples of phosphorus-containing inorganic alkaline detergent builders, when present, include the water-soluble salts 25 especially alkali metal pyrophosphates, orthophosphates, and polyphosphates. An example of phosphorus-containing organic alkaline detergent builder, when present, includes the water-soluble salts of phosphonates. Examples of non-phosphorus-containing inorganic builders, when present, include water-30 soluble alkali metal carbonates, borates and silicates as well as the various types of water-insoluble crystalline or amorphous alumino silicates of which zeolites are the best-known representatives.

ammonium and substituted ammonium, citrates, succinates.

polycarboxylates, polyacetyl carboxylates and polyhydroxysul-phonates.

Other suitable organic builders include the higher molecular 5 weight polymers and co-polymers known to have builder properties, for example appropriate polyacrylic acid, polymaleic and polyacrylic/polymaleic acid copolymers and their salts.

The dishwashing detergent composition may contain bleaching agents of the chlorine/bromine-type or the oxygen-type. Examples of inorganic chlorine/bromine-type bleaches are lithium, sodium or calcium hypochlorite and hypobromite as well as chlorinated trisodium phosphate. Examples of organic chlorine/bromine-type bleaches are heterocyclic N-bromo and N-15 chloro imides such as trichloroisocyanuric, tribromoisocyanuric, dibromoisocyanuric and dichloroisocyanuric acids, and salts thereof with water-solubilizing cations such as potassium and sodium. Hydantoin compounds are also suitable.

The oxygen bleaches are preferred, for example in the form of an inorganic persalt, preferably with a bleach precursor or as a peroxy acid compound. Typical examples of suitable peroxy bleach compounds are alkali metal perborates, both tetrahydrates and monohydrates, alkali metal percarbonates, per
25 silicates and perphosphates. Preferred activator materials are TAED and glycerol triacetate.

The dishwashing detergent composition of the invention may be stabilized using conventional stabilizing agents for the 30 enzyme(s), e.g. a polyol such as e.g. propylene glycol, a sugar or a sugar alcohol, lactic acid, boric acid, or a boric acid derivative, e.g. an aromatic borate ester.

The dishwashing detergent composition of the invention may also contain other conventional detergent ingredients, e.g. defloc-culant material, filler material, foam depressors, anti-corrosion agents, soil-suspending agents, sequestering agents, anti-

cides, fluorescers, thickeners and perfumes.

Finally, the polypetide of the invention may be used in conventional dishwashing detergents, e.g. in any of the detergents described in any of the following patent publications:

EP 518719, EP 518720, EP 518721, EP 516553, EP 516554, EP 516555, GB 2200132, DE 3741617, DE 3727911, DE 4212166, DE 4137470, DE 3833047, WO 93/17089, DE 4205071, WO 52/09680, 10 WO 93/18129, WO 93/04153, WO 92/06157, WO 92/08777, EP 429124, WO 93/21299, US 5141664, EP 561452, EP 561446, GB 2234980, WO 93/03129, EP 481547, EP 530870, EP 533239, EP 554943, EP 346137, US 5112518, EP 318204, EP 318279, EP 271155, EP 271156, EP 346136, GB 2228945, CA 2006687, WO 93/25651, 15 EP 530635, EP 414197, US 5240632.

Textile applications

Further polypeptides, including enzymes, of the invention with reduced allergenicity may be used in applications for purposes on the textile industry involving handling of enzyme granulates or powders.

Examples of textile applications are listed below:

25 i. Cellulolytic enzymes are widely used in the finishing of denim garments in order to provide a localized variation in the colour density of the fabric (Enzyme facilitated "stone wash").

ii. Bio-Polishing

30 Also cellulolytic enzymes find use in the bio-polishing process. Bio-Polishing is a specific treatment of the yarn surf which improves fabric quality with respect to handle and appearance without loss of fabric wettability. Bio-polishing may be obtained by applying the method described e.g. in WO 35 93/20278.

considerable mechanical strain. In order to prevent breaking, they are usually reinforced by coating (sizing) with a gelatinous substance (size). The most common sizing agent is starch in native or modified form. A uniform and durable finishing can thus be obtained only after removal of the size from the fabric, the socalled desizing. Desizing of fabrics sized with a size containing starch or modified starch is preferably facilitated by use of amylolytic enzymes.

10 iiii. Bleach clean-up

In bleach clean-up catalases may serve to remove excess hydrogen peroxide.

iiiii. Silk degumming

15 Removal of gum on silk fibers with protease. (Application sheet "Novo Enzymes for Silk Degumming" is available on request)

Personal care applications

Also in the personal care technical field polypeptides accord-20 ing to the invention are of interest. In the following are listed examples of uses.

1) Proteases:

Proteases are well-known active ingredients for cleaning of 25 contact lenses. They hydrolyse the proteinaceous soil on the lens and thereby makes it soluble. Removal of the protein soil is essential for the wearing comfort.

Proteases are also effective ingredients in skin cleaning 30 products, where they remove the upper layer of dead keratinaseous skin cells and thereby makes the skin look brighter and more fresh.

Proteases are also used in oral care products, especially for 35 cleaning of dentures, but also in dentifrices.

2) Lipases:

in skin cleaning products and anti-acne products for removal of excessive skin lipids, and in creams and lotions as active ingredients for skin care.

5 Lipases can also be used in hair cleaning products (e.g. shampoos) for effective removal of sebum and other fatty material from the surface of hair.

Lipases are also effective ingredients in products for cleaning 10 of contact lenses, where they remove lipid deposits from the lens surface.

3) Oxidoreductases:

30

There are many well-known Personal Care applications of oxidoreductases. The most common is an oxidase (usually glucoseoxidase) with substrate (e.g. glucose) that ensures production of H_2O_2 , which then will initiate the oxidation of for instance SCN or I into antimicrobial reagents (SCNO or I_2) by a peroxidase (usually lactoperoxidase). This enzymatic 20 complex is known in nature from e.g. milk and saliva.

It is being utilised commercially as antimicrobial system in oral care products (mouth rinse, dentifrice, chewing gum) where it also can be combined with an amyloglucosidase to produce the glucose. These systems are also known in cosmetic products for preservation.

Antimicrobial systems comprising the combination of an oxidase and a peroxidase are know in the cleaning of contact lenses.

Other applications of oxidoreductases are the application of oxidases, peroxidases and laccases in oxidative hair dyeing

Further, free radicals formed on the surface of the skin (and 35 hair) known to be associated with the ageing process of the skin (spoilage of the hair).

destruction of fatty membranes, collagen, and cells.

The application of free radical scavengers such as Superoxide dismutase into cosmetics is well-known(R.L. Goldemberg, DCI, Nov. 93, 48-52).

5

Protein disulfide isomerase (PDI) is also an oxidoreductase. It can be utilised for waving of hair (reduction and reoxidation of disulfide bonds in hair) and repair of spoiled hair (where the damage is mainly reduction of existing disulfide bonds).

10

- 4) Glucanases/Carbohydrases.
- Plaque formed on the surface of teeth are composed mainly of polysaccharides. They stick to the surface of the teeth and the microorganisms. The polysaccharides are mainly α -1,6 bound 15 glucose (dextran) and α -1,3 bound glucose (mutan). The application of different types of glucanases such as mutanase and dextranase helps hydrolysing the sticky matrix of plaque, making it easier to remove by mechanical action.
- 20 Also other kinds of biofilm for instance the biofilm formed in lens cases can be removed by the action of glucanases.
 - 5) Antimicrobial polypeptides.

Antimicrobial polypeptides have widespread applications such as preservation of cosmetic products, anti-acne products, deodo...

ants and shampoos.

Food and Feed

The polypeptides with reduced allergenicity according to the 30 invention may further advantageously be used in food- and feedstuff. Specifically relevant polypeptides are enzymes selected from the group of proteases, β -glucanases, amylases, pectinases, α -galactosidases, phytases, xylanases and lipases.

35 Use of Zipper domains

Finally the invention relates to the use of Zipper_domains for reducing allergenicity of polypeptides and may be amy

15

polypeptides.

Examples of a number of Zipper domains have already been described previously.

In an embodiment the Zipper domain is a Leucine Zipper.

The Leucine Zipper may be any known Leucine Zipper which, grafted to a polypeptide, is capable of self-oligomerizing as 10 a result of association of parallel α -helical coils of two or more Leucine Zippers.

In a specific embodiment the Leucine Zipper is the yeast transcriptional factor GCN4 or modifications thereof.

If it is desired to obtain a hetero-dimeric molecule the Zipper domain may advantageously be a Fos Leucine Zipper and a Jun Leucine Zipper.

20 In another embodiment of the invention the Zipper domain is a four helical bundle or a modification thereof.

The Zipper domains may advantageously be used for reducing allergenicity of polypeptides in detergents, household 25 articles, agrochemicals, personal care products, cosmetics, toiletry, pharmaceuticals, composition used for treating textiles, food and feed etc.

Specificially the polypeptides comprising at least one Zipper 30 domain may advantageously be used in compositions and/or in context with e.g. the industrial applications previously described.

The present invention is further illustrated in the following 35 examples which should not, in any manner, be considered to limit the scope of the present invention.

METHODS AND MATERIALS

Host cells:

Escherichia coli JM105 (Yanisch-Perron et al. Gene, 33, p.

5 103-119, 1985)

Epicurian coli XL1-Blue Cells (Stratagene Cloning Systems, Ca., USA)

Escherichia coli MC1061 (Casadaban, M.J. et al., J. Mol.Biol. 138, p. 179-207, 1980).

10

Vector:

The pFab3 expression vector is the ancestor of pFab4 (Ørum, H. et al., Nucleic Acids Research, 21, p. 4491-4498, 1993). The vector contains a pelB signal sequence (Lei et al., J. of Bac-15 teriol, vol. 169, p. 4379-4383, 1987) which is under control of the inducible lacZ promoter. A SfiI site in the pelB signal makes it possible to clone the desired sequence, so that the geneproduct will be expressed In Frame with the signal sequence.

20

Parts of the pFab3 vector was not relevant for this study wherefor it was removed by SfiI and XmaI digestion. These sites were then used as sites for introducing the PCR fragment as described below. In contrast to the referred pFab4, pFab3 contains 131 bp region between the start codons of the lac2 and the pelB signal.

Primers:

30 A-termamyl (SEO ID NO 9):

5'-CA GTC ACA GAT CCT CGC GAA TTG GCC CAG CCG GCC ATG GCC GCA
AAT CTT AAT GGG ACG CTG ATG-3'

B-termamyl (SEO ID NO 10):

35 5'- CAT TCG CGA GGA CCC GGG CGG GGT GGA CGG TTT CGG TCT TTG

AAC ATA AAT TGA AAC CGA CCC-3'

Primer A-termamyl also includes the SfiI restriction site and the last two codons of the pelB signal. Primer B-termamyl includes a linker sequence (a short hinge domain of IgG3) (Plückthun, A. et al., Biochemistry, 31, p. 1579-1584, 5 1992) and a XmaI cloning site.

Plasmids:

pDN1528 (PCT/DK94/00370)

10 Signal sequence:

pelB (Lei et al., J. of Bacteriol, vol. 169, p. 4379-4383,
1987)

Linker sequence:

15 Part of IgG, hinge (Plückthun, A. et al., Biochemistry, 31, p. 1579-1584, 1992)

Materials:

fmol™ DNA-sequencing system (Cat.:#Q4100, Promega Corporation, 20 WI, USA).

α-amylase EPS assay (Cat.:#1442295, Boehringer Mannheim GmbH, Mannheim, Germany)

Enzymes:

25 Termamyl® (available from Novo Nordisk A/S)

Sfil (Cat.: #R6391, Promega Corporation, WI, USA)

XmaI (Cat.: #R6491, Promega Corporation, WI, USA)

SacI (Cat.: #R6061, Promega Corporation, WI, USA)

T4-DNA ligase (Cat.: #M1801, Promega Corporation, WI, USA)

30 AmpliTaq® DNA Polymerase (PartNo.:N801-0060, Perkin Elmer, Roche Molecular Systems, New Jersey, USA.)

Solutions:

PCR reaction buffer: dNTP(0.25mM of each), MgCl₂ 2.5mM and

35 1x PCR reaction buffer-II (PartNo.:N808-0009, Perkin Elmer, Roche Molecular Systems, New Jersey, USA.)

ma_nxx liages buffer /Cst .#Mlanl Dromens Cornoration WT

SOC medium (Sambrook, J. et al., 1989, Molecular Cloning.

A Laboratory Manual. Second edition. Cold

Spring Harbor Laboratory, New York, USA)

2xTY medium (Ausubel, F.M. et al. (Editors), 1994

5 LB-agar Current Protocols in Molecular Biology, John

LB-medium Wiley & Sons, Inc. and Greene Publishing Asso-

ciates, Inc., New York, USA)

PEG-8000 (Cat.: #P2139, Sigma Chemical Company, MO, USA).

PBS tween 20 Ausubel, F.M. et al. (Editors), 1994

10 Alkaline phosphatase Buffer (pH=9.0)

NaCl 5.844 g

 $MgCl_2, 6H_2O$ 1.02 g

Diethanol amine 10.51 g

The pH is adjusted to 9.0 with HCl, and Milli-Q water is 15 applied to 1 litre.

Stop-solution

EDTA, disodium 74.44 g

 K_2HPO_4 174.2 g

20 NAH₃ 0.2 g

The pH is adjusted to 10 with about 22.5 g KOH in Milli-Q water to 1 litre.

Equipment:

25 Bio-Rad E. coli pulser(#165-2103,Bio-Rad Laboratories, Ca USA)

Horizon 11.14 Agarose Gel apparatus. (#580-1068IL, Life Tech-nologies, Inc., MD, USA).

Applied Biosystems 394 DNA/RNA synthesizer (Applied Biosystems,

30 CA, USA).

Thermocycler Varius V 45(Hans Landgraf, GmbH, Langenhagen, Germany.)

Mini-PROTEAN II Electrophoresis Cell (#165-2940, Bio-Rad Laboratories, Ca., USA)

35 The Semi Dry Electroblotter (JKA-Biotech, Denmark)
HiTrap™ chelating column (Code no. 17-0409-01, Pharmacia LKB,
Biotechnology AB, Uppsala, Sweden)

Methods:

All general techniques are performed according to Sambrook, J. et al., Molecular Cloning. A Laboratory Manual. Second edition. Cold Spring Harbor Laboratory, New York, USA, 1989, and/or according to Ausubel, F.M. et al. (Editors), Current Protocols in Molecular Biology, John Wiley & Sons, Inc. and Greene Publishing Associates, Inc., New York, USA, 1994)

Geneclean II procedure (BIO 101, Inc., CA, USA).

10

PCR amplification of the gene encoding Termamyl[®]. The PCR reaction is performed in 50 μ l volume PCR reaction-

buffer, 1 μM of each primer A- and B-termamyl and 10 ng of the DNA template.

15

Reaction mixtures are overlaid with mineral oil and kept at 94°C for 5 minutes. Then 0.5 μ l of AmpliTaq® (5 U/ μ l) is added. The mixtures are kept at annealing temperature 70°C for 5 minutes and at elongation temperature 72°C for 2 minutes.

20

After this initial incubation the mixtures cycle 30 times (94°C 1 minute, 70°C 1 minute, 72°C 1 minute) followed by incubation at 72°C for 10 minutes using a PCR Thermocycler Varius V 45.

25

Preparation of a sequence encoding Leucine Zipper from GCN4 and linker

The four oligonucleotides are synthesized on Applied Biosystems 394 DNA/RNA synthesizer according to protocols of the supplier.

- 30 After synthesis the oligonucleotides are purified using denaturing polyacrylamide gel electrophoresis according to (Ausubel, F.M. et al., supra, 1994). 20 pmol of each oligonucleotide are mixed in a total volume of 40 μ l of 100 mM NaCl, annealed by incubation at 95°C for 5 minutes and cooled slowly
- 35 to 16°C over a period of 3 hours, this annealing mixture is used in ligation. The four oligonucleotides are as follows:

Antisense Zip Cys (1) (XmaI-SacI) (SEO ID NO 3)

5'-CA GCC CCC ACA GCC CCC ACG TTC ACC AAC AAG CTT TTT CAG ACG AGC AAC TTC GTT TTC CAG GTG GTA G-3'

5 Antisense Zip (2), (XmaI-SacI) (SEO ID NO 4)

5'-P-TT TTT GGA CAG CAG TTC TTC AAC TTT GTC TTC CAG CTG TTT CAT TCG CGA GGA C-3'

Sense Zip (1), (XmaI-SacI) (SEO ID NO 5)

10 5'-CCG GGT CCT CGC GAA TGA AAC AGC TGG AAG ACA AAG TTG AAG AAC TGC TGT CCA AAA ACT ACC ACC-3'

Sense Zip Cvs (2), (XmaI-SacI) (SEO ID NO 6)

5'-P-TG GAA AAC GAA GTT GCT CGT CTG AAA AAG CTT GTT GGT GAA CGT 15 GGG GGC TGT GGG GGC TGA GCT-3'

P indicates oligonucleotides with a phosphoryl group at the 5'-ends.

20 Transformation of XL-1 blue E. coli

The transformation is carried out by electroporation. For this purpose Epicurian coli XL1-Blue Electroporation competent Cells are used, 3 μ l of ligated DNA is used per 80 μ l of cells. The electroporation is performed using a Bio-Rad E. coli pulser set 25 at 25 μ F, 2.5 kV and 200 Ohms.

Transformation of E.coli JM105

Transformation of E. coli JM105 is done by adding 3 μ l of the 30 ligation mixture per 100 μ l of heat-shock competent cells. The preparation and transformation of the cells are made essentially as described in (Sambrook et al. 1989, supra.)

Expression and isolation of periplasmic polypeptides.

35 The expression of Termamyl®-dimer in $E.\ coli$ JM105 is done as follows. An overnight culture of JM105 harbouring the pAZ-1 plasmid in 2XTY medium with 100 μ g/ml Ampicillin and 1%

media and incubating this at 37°C for 16 hours with vigorously shaking. 100 μl of this is used as starter culture of 100 ml 2XTY medium with 100 μg/ml Ampicillin and 0.1% D(+)-Glucose, which in a 1 L shake flask is incubated at 37°C with vigorously 5 shaking. When OD550=1.0 is reached, the temperature is adjusted to 30°C and the expression is induced by adding isopropyl-β-D-thiogalactopyranoside (IPTG) to a final concentration of within 1-5 mM. The induction is carried out for 5 hours, then the cells are pelleted by gentle centrifugation and given an 10 osmotic shock for releasing the polypeptides present in the periplasmic space of the cells. This can be performed according to the procedure of Neu, H.C. and Heppel, L.A., J. Biol. Chem. 240, p. 3685-3692, 1965.

15 Characterization of expressed Termamyl@-Zipper dimer

The periplasmic fraction of induced and non-induced cells harbouring the pAZ-1 plasmid are analyzed on an SDS-page gel 4-20% Acrylamide (Laemmeli, Nature, 227, p. 680, 1970) using the Mini-Protean II (Bio-Rad Laboratories, Richmond, Ca, USA).

- 20 Samples are run with or without reducing agent dithiothreitol. Dithiothreitol (DTT) also termed Clelands reagent is a reducing agent capable of quantitatively reducing disulfide bonds (Cleland, W.W., Biochemistry, 3, p. 480, 1964). One gel is stained with Coomassie Brilliant Blue G250 according to (Neuhoff, et
- 25 al., Electrophoresis, 9, p. 255-262, 1988) and another gel is used for blotting the polypeptides onto a PVDF membrane Imobillin-P°(Cat.:#IPVH 20200, Millipore Corporation, MA, USA) using The Semidry Electroblotter. The membranes are probed using anti-Termamyl antibodies raised in rabbits against the Terma-
- 30 myl® as the primary antibody (as described in Ausubel, F.M. et al. chapter 11 section 12 and 13, supra, 1994) and anti-rabbit IgG horseradish peroxidase conjugated (Cat.:L42007, medac, GmbH, Hamburg, Germany) as secondary antibody. The polypeptides are detected with ECL™ Western blotting detection research.
- 35 (Cat.: #RPN2106, Amersham Int., Buckinghamshire, England) and recording the light emission on ordinary X-ray film.

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Purification of Termamyl® Zipper dimer

The expressed Termamyl® Zipper dimer was purified from the fermentation broth. This was done using the attached poly-His tail as the affinity tag. More specifically the purification 5 was performed using a 5 ml HiTrap™ chelating column according to the recommodations of the supplier. Further details concerning the IMAC (Immobbilized Metal Affinity Chromatography) procedure is describe in Yip et al., (1994), Molecular Biotechnology, vol. 1, p. 151-164; Fatiadi et al., (1987), CRC 10 Critical Rev. Anal. Chem. 18, p. 1-44.

Protein determination

After purification and dialysis of the Termamyl® Zipper dimer sample, spectral measurements were performed. The optical density of the sample at 280 nm were used to calculate the protein concentration of the sample. For this purpose the Lambert Beer law was used together with the calculated protein extinction coefficient of the Termamyl® Zipper dimer using the principals for this as described by Gill et al, Analytical 20 Biochemistry, 182, p. 319-326, 1989.

ELISA procedure for determination of IgG₁ positive quinea pigs ELISA microtiter plates are coated with rabbit anti-Termamyl® AAN 4080 K 452-453 1:4000 in carbonate buffer and incubated 25 over night at 4°C. The next day the plates is blocked with 2% BSA for 1 hour and washes 3 times with PBS tween 20. Termamyl® PPX 3328 1 μg enzyme protein/ml is applied to the plates, incubated for 1 hour and then washed 3 times with PBS tween 20.

30 All guinea pig samples are applied to the ELISA plates with 25 μ l sera and 25 μ l PBS buffer, incubated for 3 hours and washed 3 times with PBS tween 20.

Then goat anti-guinea pig IgG; (diluted to 1:4000 in PBS buffer)

35 is applied to the plates, incubated for 1 hour and washed 3

times-with PBS tween 20. Alkaline phosphatase rabbit anti-goat
is applied (diluted to 1:8000) and incubated for 1 hour, washed

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The alkaline phophatase is developed using p-nitrophenyl phosphate for 30 minutes at 37°C and stopped with calcium/sodium buffer comprising EDTA (pH=10) and read at OD 405/650 using a ELISA reader.

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6 double blinds are included on all ELISA plates.

Positive and negative sera values are calculated as the avarage blind values added 2 times the standard deviation. This gives 10 an accuracy of 95%.

The test is described more thoroughly in ED-9515452 available on request from Novo Nordisk A/S.

15

EXAMPLES

EXAMPLE 1

20 PCR amplification and cloning of the gene encoding Termamyl.

The primers A-termamyl and B-termamyl were designed and synthesized on Applied Biosystems 394 DNA/RNA synthesizer.

The Termamyl® encoding gene was PCR amplified using the plasmid 25 pDN1528 containing the gene encoding Termamyl® as a template.

The PCR product, a 1.5 kb fragment, was purified by preparative agarose electrophoresis followed by the Geneclean-II procedure (BIO 101, Inc., Ca., USA).

30

EXAMPLE 2

Cloning of PCR product

35 The purified 1.5 kb DNA fragment containing the sequence encoding Termamyl® was digested with 10 U of SfiI per μg DNA at

Following the Geneclean-II procedure the DNA fragment was further digested for 2 hours at 37°C with 10 U XmaI per μ g DNA. The digested DNA was again purified using Geneclean-II procedures and finally ligated to the prepared SfiI and XmaI digested pFab3. The 10 μ l ligation mixture included 0.2 μ g of insert DNA and 0.2 μ g of digested vector pFab3. The ligation was performed for 2 hours at 16°C and 14 hours at 4°C with 1 U of T4-DNA ligase.

10 The ligated material was used to transform Epicurian coli XL1-Blue Electroporation competent Cells as described above.

EXAMPLE 3

15

Identification of correct clones

Immediately after the electroporation 1 ml of freshly made SOC medium was added and the transformed cells were vigorously shaken for 1 hour at 37°C, plated onto LB-agar plates containing 100 μg/ml Ampicillin and 12.5 μg/ml Tetracyclin and incubated overnight at 37°C. The next day clones were picked randomly, transferred to 14 ml polypropylene tubes containing 2 ml of LB medium containing 100 μg/ml Ampicillin and 12.5 μg/ml Tetracyclin. After overnight incubation at 37°C and shaking at 250 rpm, plasmid DNA minipreps were prepared according to Sambrook et al., supra, 1989. The isolated plasmid DNA was analyzed by digestion with SfiI and XmaI and the digested plasmid DNA was analyzed on 1% agarose, 1xTBE gel.

30 The appearance of a DNA fragment of 1.5 kb indicated the existence of clones containing the correct fragment size. Further verification of the cloned gene was done as DNA sequencing using the fmol^m DNA-sequencing system from Promega Corporation. A construct with the correct DNA sequence of Termamyl[®] was named pAZ-½.

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EXAMPLE 4

Leucine Zipper

Introduction of a sequence encoding the Leucine Zipper of GCN4 5 a Yeast transcriptional activator (O'Shea et al. Science, 243, p. 538-542, 1989) and also encoding a flexible C-terminal extension peptide containing a Cysteine amino acid residue was carried out using four overlapping oligonucleotides (see methods section).

10

For ligation 5 μ l of the annealing mixture was added to the T4-DNA ligase buffer to which was added 5% PEG-8000, 1 Unit of T4-DNA ligase and 0.1 pmol of XmaI and SacI digested pAZ- $\frac{1}{2}$.

15 The ligated material was used to transform E. coli JM105 as described above.

EXAMPLE 5

20

Identification of clones containing the Termamyl®-Leucine Zipper construct

Immediately after the transformation 1 ml of freshly made SOC medium was added and the cells were vigorously shaken for 1 25 hour at 37°C, plated onto selective plates and incubated overnight at 37°C.

The next day clones were picked randomly, transferred to 14 ml polypropylene tubes containing 2 ml of LB medium containing 100 mg/ml Ampicillin. After overnight incubation at 37°C and shaking at 250 rpm, plasmid DNA minipreps were prepared according to (Sambrook et al., supra, 1989). The isolated plasmid DNA was analyzed by digestion with NruI (introduced by the Leucine Zipper DNA fragment), the digested and non-digested plasmid DNA were analyzed on 1% agarose, 1xTBE gel. The appearance of linearized plasmid of 4606 bp in NruI digested samples indicated

the evictoric of clones comprising the Leucine Zipper fragment.

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encing using the fmol™ DNA-sequencing system from Promega Corporation.

5 EXAMPLE 6

Expression of dimerized Termanyl®

JM105 cells harbouring the plasmid pAZ-1 were induced to express the fusion polypeptide pelB signal-Termamyl@-Linker-10 Leucine Zipper as described above. Each fusion polypeptide dimerize with other identical fusion polypeptides during expression. Cells were given osmotic shock in order to release proteins present in the periplasma. Aliquots of the isolate from both induced and non-induced cells were analyzed on SDS-15 PAGE. Samples were analyzed under reducing (sample with DTT) and non-reducing (sample without DTT) conditions. Polypeptide bands were visualised by staining with Coomassie Blue dye. Nonreduced samples of induced cells showed a distinct band at approximately 120 kDa (see figure 3) a band not present in 20 samples of non-induced cells. Reduced samples from induced cells showed a distinct band at approximately 60 kDa, while at the same time no band was seen at 120 kDa (see figure 4). In samples of non-induced cells no 60 kDa band were seen. A gel similar to the above were used to transfer the proteins to a 25 PVDF membrane via a Western blot procedure, as described above. The 120 kDa band of non-reduced samples was specifically recognized as Termamyl® confirming the expression of Termamyl® as a dimer (see figure 5).

30

EXAMPLE 7

α-amylase activity of unpurified Termamyl-Dimer.

As a test for α-amylase activity of the Termamyl®-dimer, a 35 sample of the periplasmic isolate was analyzed. It was estimated by electrophoretic analysis that this sample contained about 0.5 mg/ml of Termamyl®-dimer. Dilutions of the sample

Methods section) and compared to dilutions of Termamyl® of known activity. This assay revealed that the dimer retained more than 50% of the wild-type activity.

5

EXAMPLE 8

Introduction of a purification tag

To obtain a more pure expression product a purification tag was introduced at the C-terminal part of the Termamyl®-Zipper protein as an in-frame insertion between the Xma I and SacI sites of pAZ-½. This resulted in a nucleotide sequence encoding the Termamyl®-Zipper protein with a C-terminal tail consisiting of a Factor Xa site and the amino acid sequence His-His-His (see sequence data). Four oligonucleotides were used for this purpose (See below).

The four oligonucleotides were synthesized on Applied Biosystems 394 DNA/RNA synthesizer according to protocols of the supplier. After synthesis, the oligonucleotides were purified using denaturing polyacrylamide gel electrophoresis according to (Ausubel, F.M. et al., supra, 1994).

20 pmol of each oligonucleotide were mixed with a total volume 25 of 40 μ l of 100 mM NaCl, annealed by incubation at 95°C for 5 minutes and cooled slowly to 16°C over a period of 3 hours. This annealing mixture was used for ligation. The four oligonucleotides were as follows:

30 Antisense Zip-Xa-His (XmaI-SacI) (SEO ID NO 7)

5'-CA ATG GTG ATG ACG ACC TTC GAT GCC CCC ACA GCC CCC ACG TTC ACC AAC AAG CTT TTT CAG ACG AGC AAC TTC GTT TTC CAG GTG GTA G-3'

35 Antisense Zip. (XmaI-SacI) (SEO ID NO 4)

5'-P-TT TTT GGA CAG CAG TTC TTC AAC TTT GTC TTC CAG CTG TTT CAT

Sense Zip, (XmaI-SacI) (SEO ID NO 5)

5'-CCG GGT CCT CGC GAA TGA AAC AGC TGG AAG ACA AAG TTG AAG AAC TGC TGT CCA AAA ACT ACC ACC-3'

5 Sense Zip-Xa-His. (XmaI-SacI) (SEO ID NO 8)

5'-P-TG GAA AAC GAA GTT GCT CGT CTG AAA AAG CTT GTT GGT GAA CGT GGG GGC TGT GGG GGC ATC GAA GGT CGT CAT CAC CAT TGA GCT-3'

P indicates oligonucleotides with a phosphoryl group at the 10 5'-ends.

The oligonucleotides were designed to have extruding overhangs when hybridized: one matching the XmaI site and one matching the SacI site of pAZ-½. The preparation of the pAZ-½ for 15 ligation with the hybridized oligonucleotides, the actual ligation and transformation of competent *E. coli* JM105, were performed essentially as described in example 4 and in the Methods and Materials-section.

20 From this transformation positive clones were identified as described in Example 5 and again the DNA sequence was verified by DNA sequencing. Further, dimer Termamyl® was expressed as described in Example 6.

25

EXAMPLE 9

Allergenicity trails of dimer Termamyl®

20 Dunkin Hartley guinea pigs were exposed to 1.0 μ g monomer Termamyl® and 1.0 μ g dimer Termamyl® by intratracheal dosage as 30 described ED-9513462 available on request from Novo Nordisk A/S.

All guinea pigs were tested for the production of IgG₁ (indicating an allergic response) during 8 days using the ELISA procedure described above.

Figure 6 shows the number of Dunkin Hartley guinea pigs found

It can be seen from figure 6 the number of guinea pigs being IgG, positive at any time during the trial period is reduced for the dimer Termamyl® in comparison to the monomer Termamyl®. This proves that the allergenicity of Termamyl® can be reduced 5 by coupling Termamyl® to a Zipper domain.

SEQUENCE LISTING

5	(1) GENE	RAL INFORMATION:
10	(i)	APPLICANT: (A) NAME: Novo Nordisk A/S (B) STREET: Novo Alle (C) CITY: Bagsværd (E) COUNTRY: Dermark (F) POSTAL CODE (ZIP): DK-2880 (G) TELEPHONE: +45 4444 8888 (H) TELEFAX: +45 4449 3256
15	(ii)	TITLE OF INVENTION: A process for the production of polypeptides
	(iii)	NUMBER OF SEQUENCES: 10
20	(iv)	(A) MEDIUM TYPE: Floppy disk (B) COMPUTER: IBM PC compatible (C) OPERATING SYSTEM: PC-DOS/MS-DOS (D) SOFTWARE: Patentin Release #1.0, Version #1.30B (EPO)
25	(2) INFO	RMATION FOR SEQ ID NO: 1:
30	(i)	SEQUENCE CHARACTERISTICS: (A) LENGTH: 1593 base pairs (B) TYPE: nucleic acid (C) STRANDEDNESS: single (D) TOPOLOGY: linear
35	(ii)	MOLECULE TYPE: CONA
	(iii)	HYPOTHETICAL: NO
40		ANTI-SENSE: NO FEATURE: (A) NAME/KEY: CDS
		(B) LOCATION: 11593
45	,	SEQUENCE DESCRIPTION: SEQ ID NO: 1:
50	GCA AAT Ala Asn 1	CIT AAT GOG AOG CIG AIG CAG TAT TIT GAA TGG TAC AIG CCC Leu Asn Gly Thr Leu Met Gln Tyr Phe Glu Trp Tyr Met Pro 5 10 15
50	AAT GAC Asn Asp	GCC CAA CAT TGG AGG CGT TTG CAA AAC GAC TGG GCA TAT TTG 96 Gly Gln His Trp Arg Arg Leu Gln Asn Asp Ser Ala Tyr Leu 20 25 30
55	GCT GAA	CAC GGT ATT ACT GCC GTC TGG ATT CCC CCG GCA TAT AAG GGA 147.

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	ACG	AGC	CAA	GCG	GAT	GIG	œc	TAC	GGT	GCT	TAC	GAC	CIT	TAT	GAT	TTA	192
	Thr	Ser 50	Gln	Ala	Asp	Val	GIY 55	Tyr	GIÀ	Ala	TYP	Asp 60	TEI	ıyr	Asp	Ten	
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5	GGG	GAG	TTT Phe	CAT.	Gln	AAA Tus	Glv	Thr	Val	Ara	Thr	LWS	Tyr	Glv	Thr	AAA Lys	240
	65	414	•••		.	70	1				75		- 4			80	
	GGA	GAG	CIG	CAA	TCT	GCG	ATC	AAA	AGT	CIT	CAT	TCC	œ	GAC	ATC	AAC	288
10	Gly	Glu	Leu	Gln	Ser	Ala	Ile	Lys	Ser	Leu	His	Ser	Arg	Asp	Ile	Asn	
					85					90					95		
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15	Val	Tyr	Gly	Asp 100	Val	Val	He	Asn	105	TÀS	GIÀ	GIY	Ala	110	Ala	TIME	
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20																	400
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	145					150				·	155					160	
																AAG	528
30	yzb	Gly	Thr	Asp			Glu	Ser	Arg	Lys 170	Leu	Asn	Arg	Ile	Tyr 175	Lys	
					165					170					1,5		
	TIT	CAA	GGA	AAG	GCT	TCG	GAT	TGG	GAA	GIT	TCC	TAA	GAA	AAC	GGC	AAC	576
35	Phe	Gln	Gly	Lys 180		Trp	Asp	dan,	G1u 185	vaı	ser	ASN	GIU	Asn 190		Asn	
																	604
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	ığı	ASP	195		MEC	TYL	ALA	200	110	,	-1-	.L.	205		. — <u>F</u>		
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																CAA Gln	672
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7,	Leu	Asp	Gly	Phe	Arg	Leu	Asp	Ala	Val	Lys	His	Ile	Lys	Phe	Ser	Phe	
	225	_	_		_	230					235					240	
																ATG	768
50	Leu	Arg	Asp	Trp			His	Val	Arg			Thr	Gly	Lys	Glu	Met	
					245	•				250					255		
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	TAT Tyr	TIG Leu	AAC Asn 275	aaa Lys	ACA Thr	AAT Asn	TIT Phe	AAT Asn 280	CAT His	TCA Ser	GIG Val	TIT Phe	GAC Asp 285	GIG Val	CCG Pro	CIT Leu	864
			CAG Gln														912
			TTG Leu														96 0
15			TTT Phe														1008
			GIC Val														1056
20	ACA Thr	AGG Arg	GAA Glu 355	Ser	GCA Gly	TAC Tyr	CCT Pro	CAG Gln 360	GTT Val	TIC Phe	TAC Tyr	GGG Gly	GAT Asp 365	ATG Met	TAC Tyr	GG Gly	1104
25	ACG Thr	Lys	GGA Gly	Asp	Ser	Gln	OGC Arg 375	GAA Glu	ATT Ile	CCT Pro	GCC Ala	TTG Leu 380	Lys	CAC His	aaa Lys	ATT Ile	1152
30	GAA Glu 385	Pro	ATC Ile	TIA Leu	AAA Lys	GCG Ala 390	AGA Arg	aaa Lys	CAG Gln	TAT Tyr	GOG Ala 395	Tyr	GGA Gly	GCA Ala	G)n	CAT His 400	1200
35	Asp	TAI Tyr	TIC Phe	GAC Asp	CAC His 405	His	GAC Asp	ATT	GTC Val	GGC Gly 410	Trp	ACA Thr	AGG Arg	GAA Glu	GGC Gly 415	CAC Asp	1248
	Ser	TOG	GIT Val	GCA Ala 420	Asn	TCA Ser	GIY	TIG	GOG Ala 425	Ala	TIA	ATA Ile	ACA Thr	GAC Asp 430	Gly	Pro	129 6
40	GGI	Gly	GCA Ala 435	Lys	CGA Arg	ATG Met	TAI Tyr	GIC Val 440	Gly	COGG Arg	Glr	AAC AST	GCC Ala 445	Gly	GAG Glu	ACA Thr	1344
45	Try	CAI His 450	a Asp	C ATI	ACC Thr	Gly	AAC Asr 455	Arg	TOG Ser	GAG	Pro	GTI Val 460	[Va]	ATC	CAA:	TOG Ser	1392
50	GA/ Glu 465	ı Gly	TC Tr	G GCZ	A GAG / Glu	TTI Phe 470	His	GIP Val	AAC Ast	Gly	GG(Gl)	y Sea	GIT Val	r TCP L Ser	ATT	TAT Tyr 480	1440
55	Va	r CAN	A AGE	A COO	3 AA 2 Lys 485	s Pro	Sea	Thu	e coo	Pro	o Gly	y Sea	c Sea	c Arg	y Met	G AAA Lys 5	1488

	CAG Gln	CIG Leu	GAA Glu	GAC Asp 500	aaa Lys	GIT Val	GAA Glu	GAA Glu	CIG Leu 505	CIG Leu	TCC Ser	aaa Lys	AAC Asn	TAC Tyr 510	CAC His	CIG Leu	1536
5	GAA Glu	AAC Asn	GAA Glu 515	GIT Val	GCT Ala	OGT Arg	CIG Leu	AAA Lys 520	AAG Lys	CIT Leu	GIT Val	GT Gly	GAA Glu 525	OGT Arg	Gly	GC Gly	1584
		GG Gly 530	_														1593
15	(2)		(i) S	SEQUE A) LI	NCE NGII	SEQ CHAF I: 53	ACTI	RIS nino	TCS:								
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25	Ala 1	Asn	Leu	Asn	Gly 5	Thr	Leu	Met	Gln	Tyr 10	Phe	Glu	Trp	Tyr	Met 15	Pro	
20	Asn	Asp	Gly	Gln 20	His	Trp	Arg	Arg	Leu 25	Gln	Asn	Asp	Ser	Ala 30	Tyr	Leu	
30	Ala	Glu	His 35		Ile	Thr	Ala	Val 40	Trp	Ile	Pro	Pro	Ala 45		Lys	Gly	
35	Thr	Ser 50		Ala	Asp	Val	Gly 55	Tyr	Gly	Ala	Tyr	Asp 60	Leu	Tyr	Asp	Leu	
	Gly 65		Phe	His	Gln	Lys 70	Gly	Thr	Val	Arg	Thr 75		Tyr	Gly	Thr	Lys 80	
40	Gly	Glu	Leu	Gln	Ser 85		Ile	Lys	Ser	Leu 90		Ser	Arg	Asp	Ile 95	Asn	
45		Tyr	Gly	Asp		Val	Ile	Asn	His 105	Lys	Gly	Gly	Ala	Asp 110	Ala	Thr	
45	Glu) Asp	Val 115		Ala	Val	Glu	Val 120		Pro	Ala	Asp	Arg 125	asn i	Arg	Val	
50		Ser 130		Glu	His	Leu	Ile 135		Ala	Trp	Thr	His 140	Phe	His	Phe	Pro	
	Gly 145		Gly	Ser	Thr	Tyr 150		Asp	Phe	Lys	Trp 155	His	Tr	Tyr	His	Phe 160	

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- Phe Gln Gly Lys Ala Trp Asp Trp Glu Val Ser Asn Glu Asn Gly Asn Tyr Asp Tyr Leu Met Tyr Ala Asp Ile Asp Tyr Asp His Pro Asp Val Ala Ala Glu Ile Lys Arg Trp Gly Thr Trp Tyr Ala Asn Glu Leu Gln 10 Leu Asp Gly Phe Arg Leu Asp Ala Val Lys His Ile Lys Phe Ser Phe Leu Arg Asp Trp Val Asn His Val Arg Glu Lys Thr Gly Lys Glu Met Phe Thr Val Ala Glu Tyr Trp Gln Asn Asp Leu Gly Ala Leu Glu Asn Tyr Leu Asn Lys Thr Asn Phe Asn His Ser Val Phe Asp Val Pro Leu His Tyr Gln Phe His Ala Ala Ser Thr Gln Gly Gly Tyr Asp Met 25 Arg Lys Leu Leu Asn Gly Thr Val Val Ser Lys His Pro Leu Lys Ser Val Thr Phe Val Asp Asn His Asp Thr Gln Pro Gly Gln Ser Leu Glu Ser Thr Val Gln Thr Trp Phe Lys Pro Leu Ala Tyr Ala Phe Ile Leu Thr Arg Glu Ser Gly Tyr Pro Gln Val Phe Tyr Gly Asp Met Tyr Gly Thr Lys Gly Asp Ser Gln Arg Glu Ile Pro Ala Leu Lys His Lys Ile 40 Glu Pro Ile Leu Lys Ala Arg Lys Gln Tyr Ala Tyr Gly Ala Gln His Asp Tyr Phe Asp His His Asp Ile Val Gly Trp Thr Arg Glu Gly Asp Ser Ser Val Ala Asn Ser Gly Leu Ala Ala Leu Ile Thr Asp Gly Pro Gly Gly Ala Lys Arg Met Tyr Val Gly Arg Gln Asn Ala Gly Glu Thr
 - 450 455 460 55 Glu Gly Trp Gly Glu Phe His Val Asn Gly Gly Ser Val Ser Ile Tyr

Trp His Asp Ile Thr Gly Asn Arg Ser Glu Pro Val Val Ile Asn Ser

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	Val	Gln	Arg	Pro	Lys 485	Pro	Ser	Thr	Pro	Pro 490	Gly	Ser	Sec	Arg	Met 495	Lys		
5	Gln	Leu	Glu	Asp 500	Lys	Val	Glu	Glu	Leu 505	lei	Ser	Lys	Asn	Tyr 510	His	Leu		
	Glu	Asn	Glu 515	Val	Ala	Arg	Leu	<i>Ly</i> s 520	Lys	Leu	Val	Gly	Glu 525	Arg	Gly	Gly		
10	Cys	Gly 530	Gly												•			
	(2)	INFO	RMAI	MON	FOR	SEQ	ID 1	10:	3:									
15		(i)	() (E	A) LI 3) T	engii Ype: Irani	1: 69 nucl) bas leic	se pa acid	airs 1									
20		(ii)	(I	O) TO	DPOL	CY:	line	ear		NA.								
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25		(xi)	SE	QUEN	CE D	ESCR	PM	ON:	SEQ :	ID N): 3:	•						
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30	AGG.	IGGIZ	Æ															69
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35		(i)	() () ()	A) Li B) T C) S	CE CI ENGII YPE: IRANI OPOLI	H: 5 nuc Dedn	4 bas leic ESS:	se p aci sin	airs d									
40		(ii)) MO	LECU	LE T	YPE:	syn	thet	ic D	NZA.			•					
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	TTT	TIGG	ACA (GCAG	TICT	IC A	ACIT	IGIC	TTC	CAGC	IGIT	TCA	TICG	OGA	GGAC			5
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	(iv) ANTI-SENSE: NO	
	(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 5:	
5 000	SCICCIC GOGAATCAAA CAGCIGGAAG ACAAAGIIGA AGAACIGCIG TOCAAAAACI	60
ACC	voc	66
10 (2)	INFORMATION FOR SEQ ID NO: 6:	
15	(i) SEQUENCE CHARACTERISTICS: (A) LENGIH: 65 base pairs (B) TYPE: nucleic acid (C) STRANDEDNESS: single (D) TOPOLOGY: linear	
	(ii) MOLECULE TYPE: synthetic DNA	
20	(iv) ANTI-SENSE: NO	
	(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 6:	
	AAAACCA AGITGCTOGT CTGAAAAACC TTGTTGGTCA ACGIGGGGGC TGTGGGGGCCT	60
25 GAG	cr	65
(2) 30	INFORMATION FOR SEQ ID NO: 7: (i) SEQUENCE CHARACTERISTICS: (A) LENGTH: 90 base pairs (B) TYPE: nucleic acid	
35	(C) STRANDEDNESS: single (D) TOPOLOGY: linear	
	(ii) MOLECULE TYPE: synthetic DNA	
40	(iv) ANTI-SENSE: YES	
40	(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 7:	
CA	ATEGICAT CACCACCTIC CATCOCCCCA CAGCCCCCAC GITCACCAAC AAGCITTITC	60
45 AG	ACCACCAA CITCCTTTIC CACCICCTAG	90
-) INFORMATION FOR SEQ ID NO: 8:	
50	(i) SEQUENCE CHARACTERISTICS: (A) LENGTH: 86 base pairs (B) TYPE: nucleic acid (C) STRANDEDNESS: single	
ፍፍ	(D) TOPOLOGY: linear	

	(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 8:	
	TGGAAAACGA AGITICCTOGT CTGAAAAAGC TIGITIGGIGA ACGIGGGGGC TGIGGGGGCA	60
5	TOGAAGGTOG TCATCACCAT TGAGCT	86
	(2) INFORMATION FOR SEQ ID NO: 9	
10	(i) SEQUENCE CHARACTERISTICS: (A) LENGIH: 65 base pairs (B) TYPE: nucleic acid (C) STRANDEDNESS: single (D) TOPOLOGY: linear	
15	(ii) MOLECULE TYPE: primer	
	(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 9:	
20	CACTUACACA TOCTOGOCAA TIGGOOCAGC OGGOCATGGC OGCAAATCIT AATGGGACGC	60
20	TCATG	6 5
	(2) INFORMATION FOR SEQ ID NO: 10:	
25	(i) SEQUENCE CHARACTERISTICS: (A) LENGTH: 63 base pairs (B) TYPE: nucleic acid (C) STRANDEDNESS: single (D) TOPOLOGY: linear	
30		
	(ii) MOLECULE TYPE: primer	
	(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 10:	
35	CATTOGOGAG GACCOGGGGGGGGGGGGGGGGGGGGGGGGGGGG	60
	∞	63

PATENT CLAIMS

- 1. A process for producing a polypeptide with reduced allergenicity, by
- 5 a) fermenting a microorganism capable of producing said polypeptide, and
 - b) recovering said polypeptide in substantially pure form, wherein said microorganism is modified in a manner whereby the expressed polypeptide molecules self-oligomerize.

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- 2. The process according to claim 1, wherein said microorganism is modified by the introduction of one or more DNA constructs comprising at least one DNA sequence coding for at least one polypeptide and at least one Zipper domain operably 15 linked to each other.
 - 3. The process according to claim 2, wherein the Zipper domain is an α -helical bundle comprises from two, three, four, five, six or seven helices

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- 4. The process according to claims 1 and 2, wherein the said Zipper domain is a Polar Zipper of poly(L-glutamine) repeats.
- 5. The process according to any of the claims 2 to 3, wherein 25 the Zipper domain comprises an amphiphilic helical bundle.
 - 6. The process according to any of claims 2, 3 and 5, wherein the Zipper domain is a Leucine Zipper or a modification thereof.

- 7. The process according to claim 6, wherein the Zipper domain results in the formation of a hetero-dimer.
- 8. The process according to claim 7, wherein one Leucine 35 Zipper is a Fos Leucine Zipper and the other is a Jun Leucine Zipper.

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- a cysteine is included in the Leucine Zipper.
- 10. The process according to any of claims 2, 3 and 5, wherein the Zipper domain is an antiparallel four-helical bundle or a 5 modification thereof.
- 11. The process according to any of claims 1 to 10, wherein said DNA construct comprises an operably inserted linker sequence between the DNA sequence coding for said polypeptide and 10 the DNA sequence coding for said Zipper domain.
 - 12. The process according to any of the claims 1 to 11, wherein the DNA sequence encodes an enzyme.
- 15 13. The process according to claim 12, wherein the DNA sequence encodes at least one enzyme selected from the group comprising proteases (metallo, acid, neutral or alkaline), lipases, cellulases, amylases, lyases, xylanases, pectinases, pullulanase, polygalacturonases, oxidases, laccases, oxidoreductases, transpolygalacturonases, α -galactosidases, phytases and peroxidases
- 14. The process according to any of claims 1 to 13, wherein the DNA sequence encodes polypeptides having a molecular weight of about 5 kDa to 150 kDa, preferably from 20 kDa to 100 kDa, 25 especially from 20 kDa to 80 kDa.
 - 15. The process according to any of claims 1 to 14, wherein the enzyme is Termamyl®.
- 30 16. The process according to any of claims 1 to 15, wherein the oligomerization is a dimerization.
 - 17. The process according to any of claims 1 to 15, wherein the oligomerization is a trimerization.
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18. The process according to any of claims 1 to 15, wherein the

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- 19. The process according to claim 1 to 18, wherein the micro-organism is a bacterium, a yeast or a filamentous fungus.
- 20. The process according to claim 19, wherein said bacterium 5 is selected from the group comprising grampositive bacteria such as strains of Bacillus, such as strains of B. subtilis, B. licheniformis, B. lentus, B. brevis, B. stearothermophilus, B. alkalophilus, B. amyloliquefaciens, B. coagulans, B. circulans, B. lautus, B. megaterium or B. thuringiensis, or strains of 10 Streptomyces, such as S. lividans, S. murinus or S. griseus, or gramnegative bacteria such as Escherichia coli.
 - 21. The process according to claim 20, wherein the host cell is B. licheniformis or E. coli.
- 22. The process according to claim 19, wherein said yeast is selected from the group comprising Saccharomyces spp. or Schizosaccharomyces spp., in particular strains of Saccharomyces cerevisiae or Saccharomyces kluyveri, or cells are strains of Kluyveromyces, such as K. lactis, Hansenula, such as H. polymorpha, or Pichia, in particular P. pastoris.
- 23. The process according to claim 19, wherein said filamentous fungus is selected from the group comprising Aspergillus spp., 25 Neurospora spp., Fusarium spp. or Trichoderma spp., in particu-
- lar strains of A. oryzae, A. nidulans or A. niger or F. oxysporum.
- 24. A DNA construct for producing polypeptides with reduced 30 allergenicity comprising a DNA sequence encoding at least one polypeptide and at least one Zipper domain operably linked to each other.
- 25. The DNA construct according to claim 24, comprising a 35 linker sequence inserted operably between DNA coding for the parent polypeptide and DNA coding for said Zipper domain.

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- a DNA sequence which when expressed exhibits at least one enzymatic activity.
- 27. The DNA construct according to claim 26, capable of sexpressing an enzyme selected from the group comprising proteases (metallo, acid, neutral or alkaline), lipases, cellulases, amylases, lyases, xylanases, pectinases, polygalacturonases, oxidases, laccases, oxidoreductases, transglutaminases, α-galactosidases, phytases or peroxidases.

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28. The DNA construct according to any of claims 24 to 27, wherein the DNA sequence encodes polypeptides with a molecular weight of about 5 kDa to 150 kDa, preferably from 20 kDa to 100 kDa, especially from 20 kDa to 80 kDa.

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- 29. The DNA construct according to any of claims 24 to 28, wherein the enzyme is Termamyl®.
- 30. The DNA construct according to any of claim 24 to 29, com-20 prising the DNA sequence shown in SEQ ID NO 1.
 - 31. A recombinant vector or transformation vehicle, comprising a DNA construct according to any of claims 24 to 30.
- 25 32. The vector according to claim 31, wherein said DNA construct is operably linked to a secretion signal.
 - 33. The vector according to claims 31 and 32, wherein said DNA construct comprise a sequence encoding an affinity tag.

- 34. The vector according to any of claims 31 to 33, wherein said vector is the pAZ-1 plasmid.
- 35. A cell comprising a DNA construct according to any of 35 claims 24 to 30 or a recombinant vector or expression vector according to any of claims 31 to 34.

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bacterium, a yeast or a filamentous fungus.

- 37. The cell according to claim 36, wherein said bacterium is selected from the group comprising grampositive bacteria such 5 as strains of Bacillus, such as strains of B. subtilis, B. licheniformis, B. lentus, B. brevis, B. stearothermophilus, B. alkalophilus, B. amyloliquefaciens, B. coagulans, B. circulans, B. lautus, B. megaterium or B. thuringiensis, or strains of Streptomyces, such as S. lividans, S. murinus or S. griseus, 10 or gramnegative bacteria such as Escherichia coli.
 - 38. The cell according to claim 37, wherein the cell is B. licheniformis or E. coli.
- 15 39. The cell according to claim 36, wherein said yeast cell is selected from the group comprising Saccharomyces spp. or Schizosaccharomyces spp., in particular strains of Saccharomyces cerevisiae or Saccharomyces kluyveri, or cells are strains of Kluyveromyces, such as K. lactis, Hansenula, such as H. 20 polymorpha, or Pichia, in particular P. pastoris.
- 40. The cell according to claim 36, wherein the filamentous fungus is selected from the group comprising Aspergillus spp., Neurospora spp., Fusarium spp. or Trichoderma spp., in particular 25 lar strains of A. oryzae, A. nidulans or A. niger or F. oxysporum.
 - 41. A microbially produced polypeptide with reduced allexgenicity produced according to any of claims 1 to 23.
 - 42. The polypeptide according to claim 41, comprising from 2 to 10 polypeptide molecules.
 - 43. The polypeptide according to claim 42 is a dimer.

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44. The polypeptide according to claim 42 is a trimer.

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- 46. The polypeptide according to any of claims 41 to 45, exhibiting enzymatic activity.
- 47. The polypeptide according to claim 46, exhibiting at least 5 one enzyme activity exhibited by enzymes selected from the group comprising proteases (metallo, acid, neutral or alkaline), lipases, cellulases, amylases, lyases, xylanases, pectinases, pullulanase, polygalacturonases, oxidases, laccases, oxidoreductases, transglutaminases, α-galactosidases, phytases 10 and peroxidases
- 48. The polypeptide according to any of claims 41 to 47, where-in the monomeric polypeptide molecule has a molecular weight of about 5 kDa to 150 kDa, preferably from 20 kDa to 100 kDa, 15 especially from 20 kDa to 80 kDa.
 - 49. The polypeptide according to any of claims 41 to 48, where in the enzyme exhibits α -amylase activity.
- 20 50. An oligomeric polypeptide with reduced allergenicity comprising at least one polypeptide bonded or linked to at least one Zipper domain which is coupled to at least one polypeptide bonded or linked to at least one Zipper domain.
- 25 51. The oligomeric polypeptide according to claim 50, wherein the Zipper domain comprises an α -helical bundle.
- 52. The oligomeric polypeptide according to claim 51, wherein the said α -helical bundle comprises two, three, four, five, six 30 or seven helices.
 - 53. The oligomeric polypeptide according to any of the claims 50 to 52, wherein the Zipper domain comprises an amphiphilic helical bundle.
 - 54. The oligomeric polypeptide according to claim 50, wherein

55. The oligomeric polypeptide according to any of claims 50 to 53, wherein the Zipper domain is a Leucine Zipper or a modification thereof.

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- 56. The oligomeric polypeptide according to claims 54 and 55, wherein the Zipper domain oligomerization results in the formation of a hetero-dimer.
- 10 57. The oligomeric polypeptide according to claim 56, wherein one Leucine Zipper is a Fos Leucine Zipper and the other is a Jun Leucine Zipper.
- 58. The oligomeric polypeptide according to any of the claims 15 55 to 57, wherein a cysteine is included in the Leucine Zipper.
 - 59. The oligomeric polypeptide according to any of claims 50 to 58, wherein the Zipper domain is an antiparallel four-helical bundle or a modification thereof.

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60. The oligomeric polypeptide according to any of claims 50 to 59, wherein said DNA construct comprises an operably inserted linker sequence between the DNA sequence coding for said polypeptide and the DNA sequence coding for said Zipper domain.

- 61. The oligomeric polypeptide according to any of claims 50 to 60 wherein said polypeptide exhibits enzymatic activity.
- 62. The oligomeric polypeptide according to claims 61, wherein 30 the polypeptide exhibits at least one enzyme activity exhibited by enzymes selected from the group comprising proteases (metallo, acidic, neutral or alkaline), lipases, cellulases, amylases, lyases, xylanases, pectinases, pullulanase, polygalacturonases, oxidases, laccases, oxidoreductases, transglutaminases, 35 α-galactosidases, phytases and peroxidases
 - 63. The oligomeric polypeptide according to any of claims 61 to

weight of about 5 kDa to 150 kDa, preferably from 20 kDa to 100 kDa, especially from 20 kDa to 80 kDa.

- 64. The oligomeric polypeptide according to any of claims 61 to 5 63, wherein the enzyme exhibits α -amylase activity.
 - 65. The oligomeric polypeptide according to any of claims 50 to 59, wherein said Zipper domain is linked to said polypeptide and the C-terminal of the polypeptide.

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- 66. The oligomeric polypeptide according to any of claims 50 to 59, wherein said Zipper domain is linked to said polypeptide and the N-terminal of the polypeptide.
- 15 67. A composition comprising at least one polypeptide according to any of the claims 41 to 49 and/or at least one oligomeric polypeptides according to any of claims 50 to 66.
- 68. The composition according to claim 67, comprising ingredi20 ents normally used in detergents, household articles, agrochemicals, personal care products, cosmetics, toiletry, pharmaceuticals, composition use for treating textiles, food and/or
 feed.
- 25 69. Use of Zipper domains for reducing allergenicity of polypeptides.
 - 70. The use according to claim 69, wherein said Zipper domeins are used for oligomerizing polypeptide molecules.

- 71. The use according to claims 69 and 70, for a process according to any of claims 1 to 23 or in oligomeric polypeptides according to any of claims 50 to 66.
- 35 72. The use according to any of claims 69 to 71, wherein the Zipper domain comprises two, three, four, five, six or seven α -

- 73. The use according to any of claims 69 to 71, wherein the said Zipper domain is a Polar Zipper of poly(L-glutamine) repeats or a modification thereof.
- 5 74. The use according to any of the claims 71 and 72, wherein said Zipper domain comprises an amphipathic helical bundle.
- 75. The use according to any of claims 71, 72 and 74, wherein said Zipper domain is a Leucine Zipper or a modification there-
 - 76. The use according to claim 75, wherein the Leucine Zipper is a Fos-Jun Leucine Zipper.
- 15 77. The use according to any of the claims 75 and 76, wherein a cysteine is included in the Leucine Zipper.
- 78. The use according to any of claims 71, 72 and 74, wherein said Zipper domain is an antiparallel four-helical bundle or a 20 modification thereof.
 - 79. The use according to any of claims 69 to 78, in household articles.
- 25 80. The use according to any of claims 69 to 78, in detergents, including dishwashing detergents and soap bars.
 - 81. The use according to any of claims 69 to 78, in personal care products.
 - 82. The use according to claim 81, in oral care products including cleaning products for dentures and dentifrices.

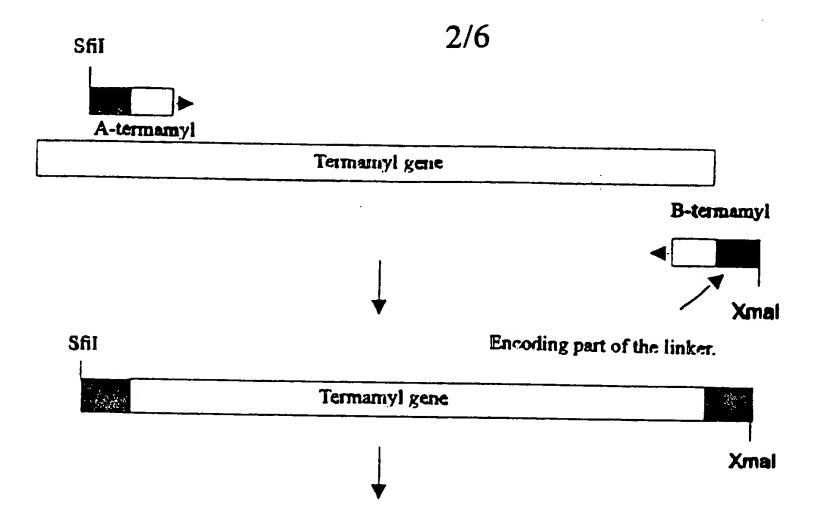
- 83. The use according to claim 81, in skin care products inclu-35 ding creams and lotions.
 - 84. The use according to claim 81, in hair care or hair treat-

- 85. The use according to claim 81, in contact lens cleaning products.
- 86. The use according to any of claims 69 to 78, in cosmetics.
- 87. The use according to any of claims 69 to 78, in pharmaceuticals.
- 88. The use according to any of claims 69 to 78, in agrochemi-10 cals.
 - 89. The use according to any of claims 69 to 78, in food and feed.

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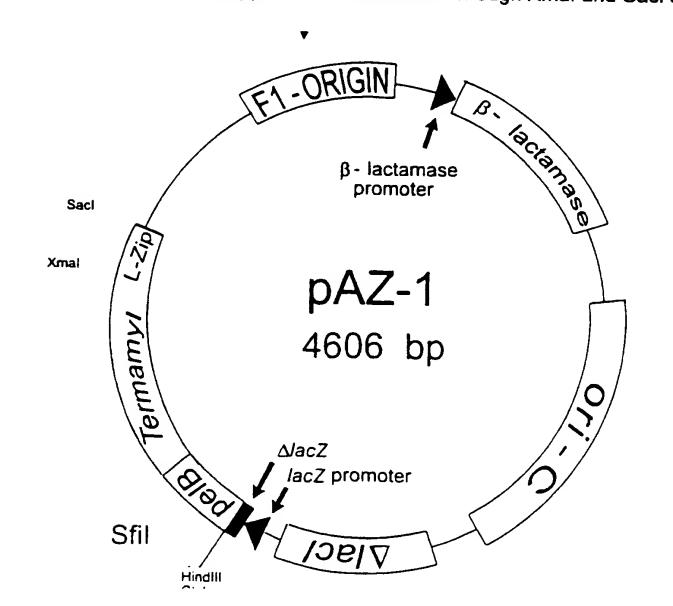
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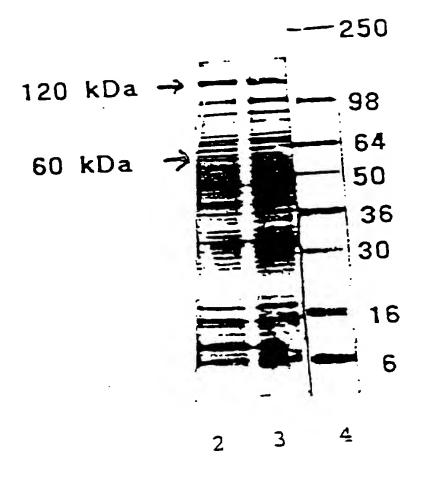
Figure 1

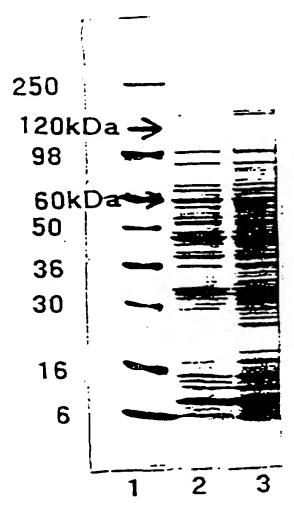


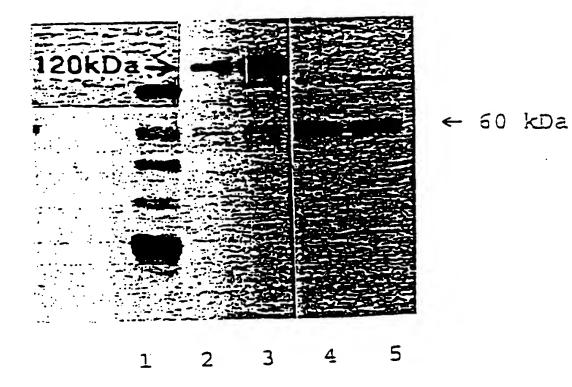
Sfil-Xmal digested fragment is inserted into Sfil-Xmal digested pFab3.

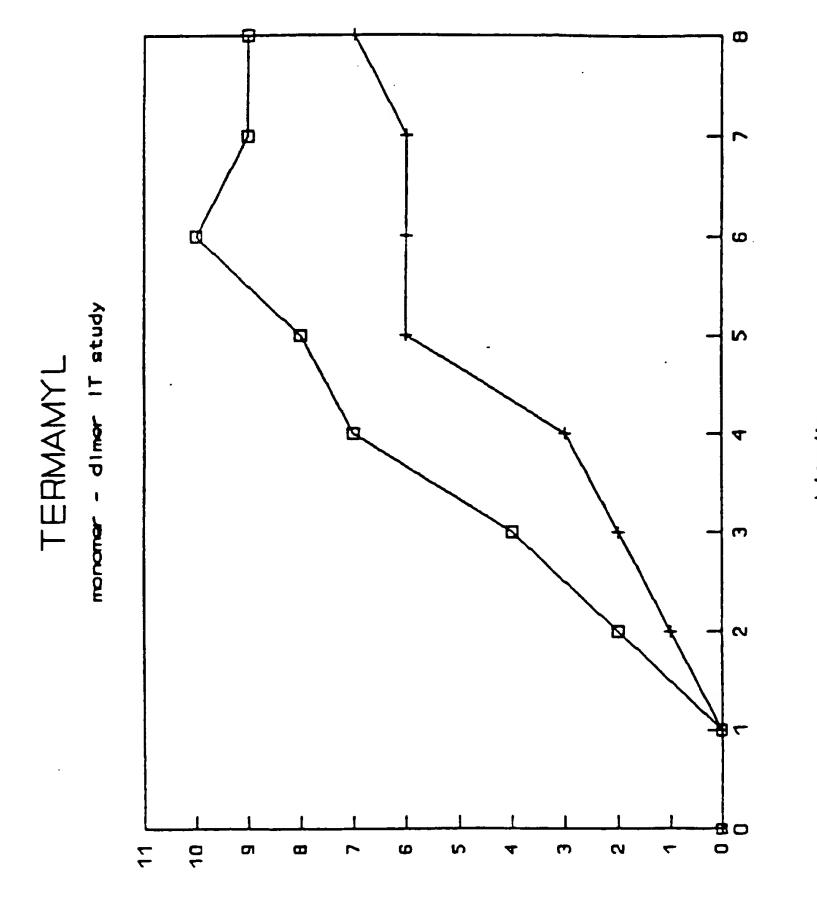
Linker encoding Leucine Zipper GCN4 is inserted through Xmal and Sacl sites.











bleeding 1,0 μg MONOMER + 1,0 μg DIMER

INTERNATIONAL SEARCH REPORT

International application No. PCT/DK 95/00463

CLASSIFICATION OF SUBJECT MATTER

IPC6: C12N 15/62, C12N 9/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: C12N, C07K, C12P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

MEDLINE, BIOSIS, EMBASE, WPI, WPIL, US PATENTS FULLTEXT DATABASES, SCISEARCH

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
Х	WO 9410308 A1 (IMMUNEX CORPORATION), 11 May 1994 (11.05.94), page 2, line 22 - line 24, the claims	1-68		
Y		69-89		
ļ				
A	WO 9410191 A1 (NOVO NORDISK A/S), 11 May 1994 (11.05.94), page 3, line 33 - line 36; page 4, line 1 - line 8; page 4, line 26 - line 36, the claims and the abstract	1-68		
Y		69-89		
				

	Further documents are listed in the continuation of Box	C .	X See patent family annex.				
•	Special categories of cited documents:	T	later document published after the international filing date or priorit				
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-E-	•	'X'	document of particular relevance: the claimed invention cannot be				
٠٢.	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other		considered novel or cannot be considered to involve an inventive step when the document is taken alone				
	special reason (as specified)	-Y-	document of particular relevance; the claimed invention cannot be				
.0.	document referring to an oral disclosure, use, exhibition or other means		considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art				
P			-				
1	the priority date claimed	*& *	document member of the same patent family				
Dat	te of the actual completion of the international search	Date	of mailing of the international search report				
I							

21 March 1996

26 -03- 1996

INTERNATIONAL SEARCH REPORT

Information on patent family members

05/02/96

International application No.
PCT/DK 95/00463

	document ' arch report	Publication date	Patent family member(s)	Publication date		
WO-A1-	9410308	11/05/94	NONE			
WO-A1-	9410191	11/05/94	NONE			

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